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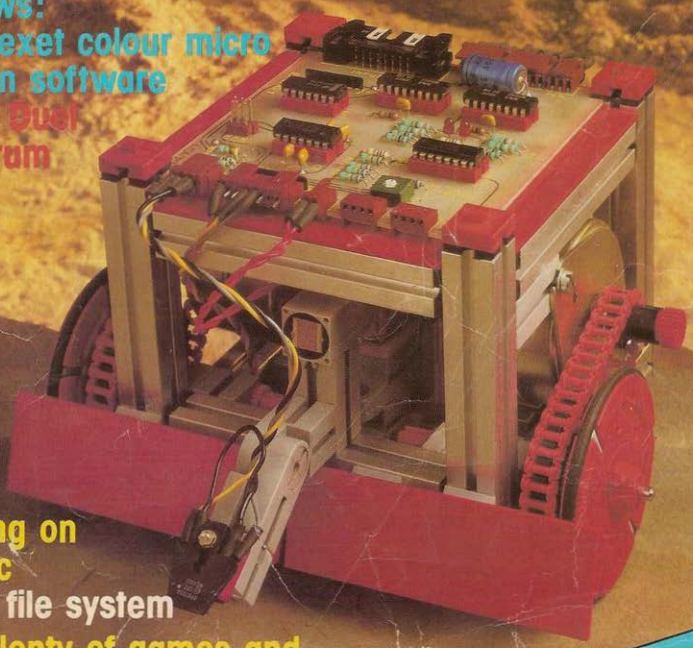

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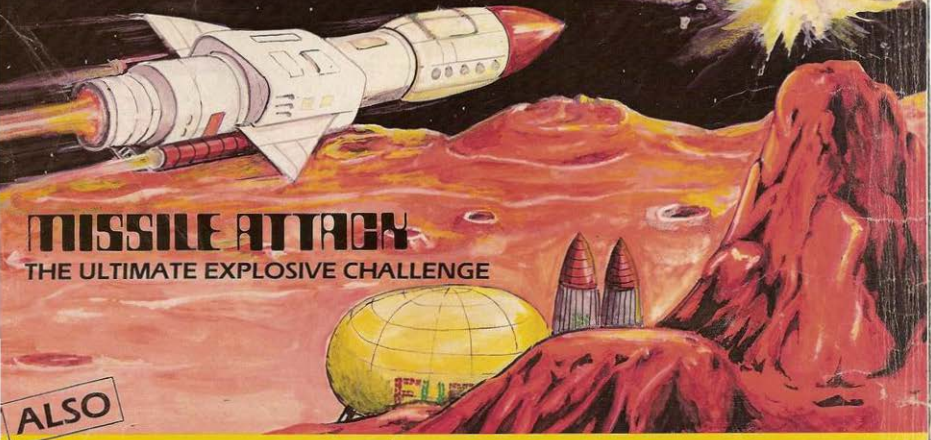

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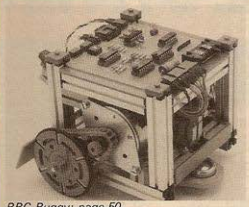

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Atari toad: page 76.

ZX-81 Ground strike: page 84.

6502 machine code series: page 103.

MACHINE CODE

Cover photograph by Stephen Oliver

28 **EDITORIAL AND YOUR LETTERS:** Lynx lovers; Dutch Dragon doublers; Swiss tipsters; and the Riddle's black rod. Are micros corrupting the nation's youth?

30 **NEWS:** ZX-83, ZX-84, and Microdrive latest; Peanut — the £300 Apple look-alike; talking cars; computing for the blind; £170 Texas portable; £10 computer repair garages.

37 **COMPUTER CLUB:** Stopping just short of world domination, north London's Queen's Crescent club is spreading its message from Kentish Town to Primrose Hill.

38 **FIRST BYTES:** If you have not passed Go with your brand-new micro go straight to First Bytes to collect an introduction to microcomputing and perhaps win £15 of software.

40 **DRAGON SOFTWARE SURVEY:** Save your planet, slay mythical beasts, or just take on gorillas with your bare hands — and all in the comfort of your own home.

50 **BBC BUGGY:** At last a robot that you can just plug in to your computer. Simon Beesley reviews Economatics £150 BBC Buggy — the ultimate adult toy.

56 **TEXET'S £98 COLOUR COMPUTER:** The cheapest yet. Bill Bennett reviews the Hong Kong built micro aimed at Oric and Sinclair country.

60 **VIC-20 SNAKE:** Watch out there's a killer mushroom about in Andrew Dilley's game of predatory pythons and violent vegetables for the unexpanded Vic.

64 **DRAGON REBOUND:** Quick reflexes are the key to Vincent Crockett's original game for the Dragon. How many targets can you hit in a minute?

66 **ZX-81 UNIFILE:** A comprehensive filing system for the 16K ZX-81 allowing you to make the best use of information storage on cassette.

72 **BBC MACHINE OPERATING SYSTEM:** 13 may be unlucky for some but not for Chris Melville as he explains the 13 sections of the BBC's MOS.

76 **ATARI TOAD:** Not just another Frogger program. This time you sit on a lily pad and wait for the flies to come to you.

79 **BBC MODES:** Fintan Culwin shows how to double the height and width of characters in high resolution without doubling your money.

82 **ACE CHARACTER FORMING:** Down with pseudo-descenders. Roger Liddiard gives dignity back to screen characters on the Ace.

84 **ZX-81 GROUND STRIKE:** Philip Tyler's machine-code attack game stretches the capabilities of the unexpanded ZX-81 to the limit.

88 **SPECTRUM DEATH DUEL:** A high-speed game of strategy for two players. Force your opponents into the walls of death.

95 **VIC VARIABLES:** Vic variables are a bit like spaghetti — difficult to pick up but a delight once mastered. Clive Finnis is your pasta master.

103 **6502 MACHINE CODE:** A new series to help you to get to grips with how the Vic-20, Oric, Atom and BBC Micro work.

111 **SPECTRUM ANIMATION:** Robert Newman's machine-code routines open up a new fast-action flicker-free universe.

117 **SPECTRUM COMPLEX SOUNDS:** Ronald Seniscal utilising interrupts so you can add fuss-free sound to your favourite games.

122 **HISTORY OF SOFTWARE:** John Dawson puts today's software in context with a look at the early days of computer programming.

127 **BASIC DICTIONARY:** Tony Edwards completes his A to Z of Basic but breaks into non-alphanumeric symbols in this penultimate episode.

129 **RESPONSE FRAME:** Tim Hartnell answers your computing queries.

131 **FINGERTIPS:** David Pringle's pocket computer and calculator spot.

133 **SOFTWARE FILE:** 10 program-packed pages full of games, tips, and serious applications for the Ace, Atom, ZX-81, BBC, Vic-20, Dragon, Atari and Spectrum.

WIN A TEXET: See card at page 26.

155 **COMPETITION CORNER:** New teaser; Commodore 64 winner.

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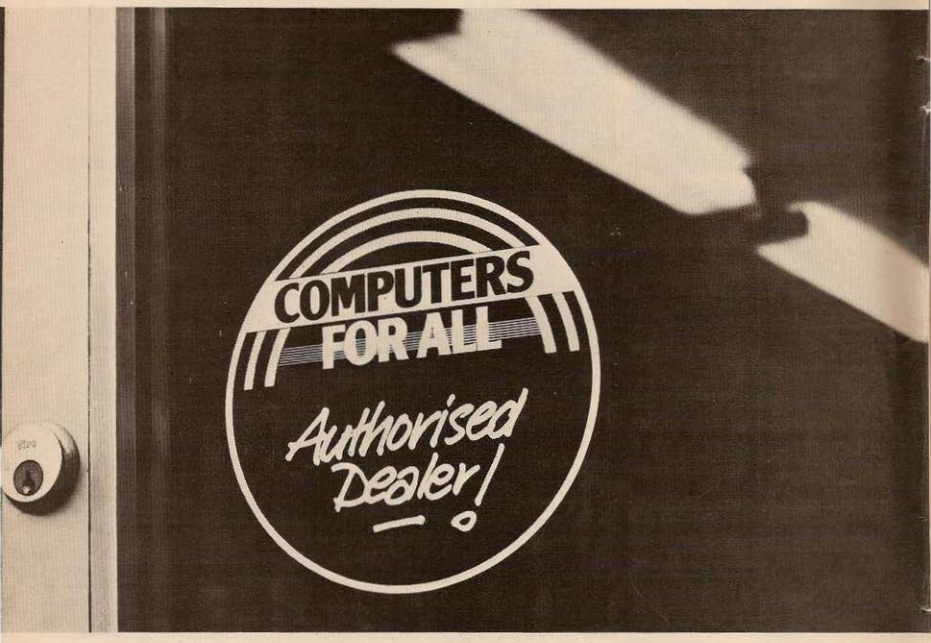

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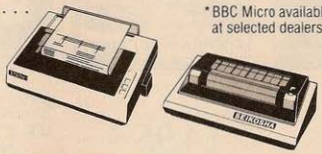

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YC0483 — Your Computer — April 1983

GEMIN

PERFORMAN

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SPECIAL LIMITED OFFER

Buy just any two programs at £19.95 and take one at £19.95 FREE!

CASH BOOKS ACCOUNTS PROGRAM FOR BBC MICRO . . .£95.00

New

One of the most innovative business programs on the market. Most serious accountancy packages are written and coded by professional and competent programmers. The Gemini Cashbook Accounting program was written by practising Chartered Accountants and coded by professional and competent programmers. This is a fundamental difference.

This practical program is simple to use and will replace your manual cash and bank records and by giving you instant management information, it may even put your accountant out of job!

With exceptionally exhaustive user documentation, full technical back up and product update policy this program will increase the efficiency and profitability of your business. Take a look at the information this program will provide.

* summary of VAT information to enable you to complete your VAT returns
* cumulative receipts and payments report analysed over the standard profit and loss and balance sheet heading.
* option for departmental analysis of sales and purchases
* print out of all transactions
* journal routine for entering transfers between accounts and year end adjustment for debtors, creditors etc.
* year end trial balance
* profit and loss account and balance sheet.

These statements can be produced at what ever interval you require e.g. monthly, quarterly or annually.

Coming soon:– Integrated Sales + Purchase Ledgers

". . . the systems worked immaculately when tested . . ."
"Maillist is a very professional piece of software . . ."
(Which Micro & Software Review Feb 83)

Here's a range of software for the independent businessman that's designed to harness the power of your micro to deliver the vital information you need in all key areas of your business. A breakthrough on both price and performance, each program is fully tested and comes with all the documentation back up you need.

"Gemini's range of software is in the vanguard of the releases for 'serious' micro users . . ."
(Which Micro and Software Review)

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BEEBCALC £19.95
DRAGONCALC £19.95

New

FOR BBC AND DRAGON 32. Spreadsheet processors have proved to be important tools for using micros in business, scientific and domestic financial applications.

Without any programming knowledge at all, you may:–

* Set up a computerised spreadsheet, with chosen row and column names.
* Specify formulae relating any row or column to any other.
* Enter your source data and have the results calculated.
* Save the results on tape (or disk – BBC) for later reloading and manipulation.
* Print the tabulated results in an elegant report format.
* Experienced users may access saved files and write their own reporting or graphics presentation programs for the results.

Some typical applications:–

* Small business accounting applications, e.g. profit and loss statements and cashflow projections, break-even analyses etc.
* Investment project appraisal – anything from double glazing to oil rigs!
* Comparing rent/lease/buy options
* Processing the results of scientific experiments or field studies
* Engineering calculation models
* In fact, anything that involves repeated re-calculation of results presented in tabular or spreadsheet format.

Program Availability Chart:–

	Database	Stock Control	Maillist	Invoices & Statements	Spread sheet Analysis	Cashbook Accounting	Word processor	Home Accounts	Commercial Accounts
Sinclair Spectrum 16k or 48k	●	●	●					●	●
Dragon 32K or 64k	●				●			●	
VIC20 (16k+)	●	●	●	●				●	●
Sinclair ZX81 (16k+)	●								
Grundy Newbrain	●								
Texas TI99 4A	●								
Osborne 1	●								
Sharp MZ80A	●	●	●	●				●	●
Sharp MZ80K	●	●	●	●				●	●
Sharp MZ80B	●	●	●	●				●	●
BBC micro model A or B 32K	●	●	●	●	●	●	●	●	●

I'S NEW
CE SOFTWARE
ur business at petty cash prices.

INVOICES AND STATEMENTS . . . £19.95

Compatible with most micros. See table. Ideal for the small business. A complete suite of programs together with generated customer file for producing crisp and efficient business invoices and monthly statements on your line printer. All calculations include VAT automatically, and the program allows your own messages on the form produced. This program gives you superb presentation and saves time on one of the most tedious tasks in the office.

COMMERCIAL ACCOUNTS . . . £19.95

Compatible with most micros. See table. A gem of a program, all for cassette, with the following features:– Daily Journal. Credit Sales. Cash Sales. Credit Purchases. Purchases – other. Sales Ledger. Purchase Ledger. Bank Account. Year to date summary. A fully interactive program suitable for all businesses. Files can be saved and loaded and totals from one file carried forward to another on cassette. Particularly useful from a cash flow point of view, with immediate accessibility to totals for debtors and creditors. Bank supported with entries for cheque numbers, credits and, of course, running balance.

MAILING LIST . . . £19.95

Compatible with most micros. See table. A superb dedicated database to allow for manipulations of names and addresses and other data. Gemini's unique 'searchkey' system gives you a further ten 'user-defined parameters' to make your own selections. Features include the facility to find a name or detail when only part of the detail is known, it will print labels in a variety of user specified formats.

DATABASE . . . £19.95

Compatible with most micros. See table. The program that everyone needs, the most valuable and versatile in your collection. Facilities include sort search, list print if required. Can be used in place of any card index application; once purchased you can write your own dedicated database to suit your particular needs with a limitless number of entries on separate cassettes.

STOCK CONTROL . . . £19.95

Compatible with most micros. See table. Dedicated software with all that's necessary to keep control of stock. This program will take the tedium out of stock control and save time and money. Routines include stock set up, user reference number, minimum stock level, financial summary, line print records, quick stock summary, add stock, delete/change record and more.

HOME ACCOUNTS . . . £19.95

Compatible with most micros. See table. Runs a complete home finance package for you with every facility necessary for keeping a track of regular and other expenses, bank account mortgage, H.P. etc. This program also allows you to plot graphically by Listograms your monthly outgoings.

WORD PROCESSOR . . . £19.95

Compatible with most micros. See table. This program features routines found in much larger and more expensive packages with a typical word length of 5-6 letters it allows for around 1000 words in memory at one time. Ideal for the user who requires a simple program to write letters on his computer. Features include, block delete, block insert, search and replace, edit text, display text and more.

Dealer/Trade enquiries invited – generous trade discounts for quantity

Special ACCESS card instant sales hotline for GUARANTEED despatch within 24 hours . . . Tel: 03952-5165

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All enquiries other than credit card sales to 03952-5832

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Tick the box for Program you require. Prices include V.A.T. and Package and Postage.
Please supply the following cassette software.

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Stock Control	£19.95 ☐	BBC Cash Book disk or tape	£95.00 ☐
Mailing List	£19.95 ☐	BBC Disks – other titles	£23.95 ☐
Invoices and Statements	£19.95 ☐	Osborne Disk Database	£23.95 ☐
Commercial Accounts	£19.95 ☐	Word processor	£19.95 ☐
Home Accounts	£19.95 ☐	Beetcalc	£19.95 ☐
		Dragoncalc	£19.95 ☐

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Machine Type_____ Memory Size_____

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NEW **ZX INVASION FORCE** (ZX81)
Use your skill to fire through the energy band to destroy the menacing alien ship — **£3.95**

NEW **SPEC INVADERS**
SPEC GOBBLEMAN
These exciting high-speed classic games incorporate hi-resolutiongraphics and sound to bring you the best in arcade action at only **£4.95** each (16/48K)

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Hop across the dangerous road avoiding the lethal cars, then lorries. Go back to the wild west for a gunfight battle amongst cacti and wagons. Features include western music. **£4.95**

NEW **NAMTIR RAIDERS** (ZX81)
High speed, quick action arcade game with four separate groups of attackers. **£3.95**

Gobbleman also available for ZX81 at **£3.95**

UTILITIES

NEW **TOOLKIT**
Nine powerful new functions for your ZX81 (including re-number lines (goto, gosub), program merge, string finding and replacement. **£5.95**

SPEC BUG
A 30 in 1 machine code tool and disassembler for your ZX Spectrum. **£6.95**

ZX BUG
A 30 in 1 machine code tool and disassembler for your ZX81. **£6.95**

Improve your machine code programs with this new 48K Spectrum Assembler

Just released by Artic, this new professional quality assembler is also available for 16K ZX81 and features:—

* Word-processor-like text editor. * High-speed, versatile two-pass mnemonic assembler with labels and detailed error-trapping. Will assemble to any address. * Essential support facilities such as memory-edit, register inspect/modify and search for de-bugging. * Full output to ZX-printer. * Memory-status report and comprehensive user-manual.

ONLY £9.95

ZX81 & SPECTRUM

NEW LOW PRICE ADVENTURE GAMES

ONLY £5.95 for ZX81 and £6.95 for SPECTRUM

INCA CURSE (Adventure B)
In a jungle clearing you come across an ancient Inca temple. Your mission to enter, collect the treasure and escape alive. But beware! Includes a cassette save routine.

SHIP OF DOOM (Adventure C)
You are unavoidably drawn to an alien cruiser. Can you reach the control room and free yourself? Or will they get you first? Includes a cassette save routine.

ESPIONAGE ISLAND (Adventure D)
While on a reconnaisance mission your plane loses control and you are forced to land. Can you survive and escape with the island's hidden secret?

PLANET OF DEATH (Adventure A) 16/48K
You find yourself stranded on an inhabited alien planet. Can you reach your ship and escape?

also available for SPECTRUM

ZX FORTH

Supplied on cassette with editor cassette, user manuals and keyboard overlay. ZX Forth combines the simplicity of basic with the speed of machine code now £14.95

THE ULTIMATE ADVENTURE FOR THE SPECTRUM/ZX81 for only £9.95

AND THE CHANCE TO WIN £10,000 or more IF YOU KRAKIT™

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KRAKIT™ TRADE MARK OF BIG PUBLISHING & FOX DRAKE INC.

Your eccentric father has left you £10,000 in his will. In order to claim your windfall you must solve twelve clues and gain access to a bank account in which the money has actually been deposited. Be the first to crack the puzzle and the prize is yours! Plus you will win two tickets to the city of the secret KRAKIT™ vault location. The Prize money is increased weekly. A telephone number will be supplied so you have the opportunity to find out just how much you could win.

DON'T MISS YOUR CHANCE TO WIN A FORTUNE!

SPECTRUM MICRO CHESS

The only Chess program for a 16K or 48K Spectrum. Allows all legal moves, castelling; en-passant and pawn promotion.
Options to play black/or white. Sets board in any position. Full colour and graphics display.

ONLY **£6.95**

new releases for 16K & 48K SPECTRUM

SPECTRUM INVASION FORCE

A popular arcade game for 16K or 48K Spectrum. Fires through the force field to destroy the menacing alien ship. Sounds easy?? Two levels of play — normal or suicidal. Full colour. Sound and hi-res. graphics.

NOW ONLY **£4.95**

A GREAT CHESS GAME FOR YOUR ZX81 OR SPECTRUM*

*SPECTRUM CHESS 48K

ZX CHESS I
Very popular machine code program, with six levels of play and an analysis option. Available for ZX81. **£6.50**

ZX CHESS II
A new improved version, with a faster response time, seven levels of play, analysis option and in addition a recommended move option. **£9.95**

ZX 1K CHESS
An incredible game in 1K for only **£2.95**

As featured on ITV

NEW **SPECTRUM VOICE CHESS**

This incredible program talks you through your game.
It tells you its move, recommends a move, and contains a range of facetious comments. The game is based on the highly successful ZX Chess II and is offered at the Christmas offer price of **£9.95**.

SPECTRUM CHESS now only **£9.95**

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TELEWRITER™
the DRAGON 32 Word Processor

TELEWRITER

Telewriter is the powerful word processor designed specifically for the DRAGON 32 Computer. It can handle almost any serious writing job and is extremely easy to use. It has all the advanced features you need to create, edit, store, format and print any kind of text. With Telewriter you can quickly produce perfect, finished copy for letters, reports, term papers, articles, technical documentation, stories, novels, screenplays, newsletters. It is also a flexible and efficient way to take notes or organize ideas and plans.

51 × 24 DISPLAY

The DRAGON 32 is an incredibly powerful and versatile computer, but for text editing it has some major drawbacks. The small 32 character by 16 line screen format shows you too little of the text and, combined with its lack of lower case letters, bears little resemblance to the way text really looks on the page. Reverse video in place of lower case just adds confusion.

Telewriter eliminates these shortcomings with **no hardware modifications required.** By using software alone, Telewriter creates a new character set that has **real lower case letters,** and puts 24 lines of 51 characters on the screen. That's more on-screen characters than Apple II, Atari or TRS-80 Model III. That's more than double the DRAGON 32's standard display.

FULL SCREEN EDITOR

The Telewriter editor is designed for maximum ease of use. The commands are single key (or single key plus control key), fast, and easy to remember. There is no need to switch between insert modes and delete modes and cursor movement modes. You simply type. What you type is inserted into the text at the cursor, on the screen. What you see on the screen is always the current state of your text. You can move quickly through the text with one key cursor movement in all 4 directions, or press the shift key simultaneously for fast, auto-repeat. You can jump to the top or bottom of the text, and beginning or end of a line, move forward or backward a page at a time, or scroll quickly up or down. When you type past the end of the line, the wordwrap feature moves you cleanly to the next.

You can copy, move or delete any size block of text, search repeatedly for any pattern of characters, then instantly delete it or replace it with another. Telewriter gives you a tab key, tells you how much space you have left in memory, and warns you when the buffer is full.

. . . truly a state of the art word processor . . . outstanding in every respect
– The RAINBOW, Jan. 1982

The only one with all these features for your DRAGON 32

51 column × 24 line screen display
Sophisticated full-screen editor
Real lower case characters
Powerful text formatter
Works with any printer
Special MX-80 driver
Requires absolutely no hardware modifications
★ Tandy colour version also available

FORMAT FEATURES

When it comes time to print out the finished manuscript, Telewriter lets you specify: left, right, top, and bottom margins, line spacing and lines per page. These parameters can be set before printing or they can be dynamically modified during printing with simple format codes in text.

Telewriter will automatically number A4 pages (if you want) and centre lines. It can chain print any number of text files from cassette without user intervention. You can tell it to start a new page anywhere in the text or pause at the bottom of the page.

You can print all or any part of the text buffer, abort the printing at any point, and there is a "Typewriter" feature which allows you to type straight to your printer. Because Telewriter lets you output numeric control codes directly (either from the menu or during printing), it works with any printer (Tandy, Seikosha, MX-80, Okidata, NEC 8023, C. Itoh 8510, Centronics, GE Terminet, Smith Corona TP-1, etc.). There's even a special driver for the Epson MX-80 that lets you simply select any of its 12 fonts and do underlining with a single underline character.

CASSETTE INPUT/OUTPUT

Because the Telewriter makes using cassette almost painless, you can still have a powerful word processor without the major additional cost of a disk. The advanced cassette handler will search in the forward direction till it finds the first valid file, so there's no need to keep retyping a load command when you are lost in your tape. The Verify command checks your cassette save to make sure they're good. You can save all or any part of the text buffer to cassette and you can append pre-existing files from those you have in the buffer already.

ASCII COMPATIBLE

Telewriter turns your DRAGON 32 into the most powerful, lowest cost, word processor in the world today. But that's not all. The simple ASCII conversion program provided with Telewriter means you can use the full power of the Telewriter editor for creating and editing BASIC and assembly language programs. It means you can use Telewriter to prepare or edit text files used with any data communications program.

Telewriter costs £49.95 on cassette and is

AVAILABLE FROM DRAGON 32 DEALERS NATIONWIDE
OR DIRECT FROM
MICRODEAL
41 TRURO ROAD, ST. AUSTELL, CORNWALL PL25 5JE
24 HOUR ORDERLINE 0726 67676

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SEND FOR OUR FREE SOFTWARE LISTS FOR DRAGON 32 & TANDY RANGE OF COMPUTERS.
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. . . one of the best programs for the Color Computer I have seen . . .
– Color Computer News, Jan. 1982

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spectrum

NEWS from SPECTRUM

ATARI 800

This **proven and tested** micro is now **UPGRADED to 48K RAM** and there's **no increase in price either** which must make it **about the best value around.** See our ad. for further details.

ATARI 400

Now **REDUCED** by a **MASSIVE £39** to an **incredible price of only £159.95** from **Spectrum.**

SINCLAIR ZX SPECTRUM

We have now added the super **SINCLAIR ZX SPECTRUM** 16K and 48K Models to our range – check our ad. for further details.

NEW SPECTRUM MEMBERS

Check our address page! – there are many new SPECTRUM dealers throughout the UK so there's a good chance there'll be a SPECTRUM centre very near you.

STOCKS

The general stock situation has now improved and you'll find that most **SPECTRUM** centres will be able to supply you **immediately** and at **super LOW prices too!**

INTRODUCING SPECTRUM FACTS!

Next to many of our offers, you'll find a few lines tagged SPECTRUM FACTS. We pride ourselves on providing **you**, the customer, with a **genuine service** as well as super LOW prices, and we want you to know that when you buy from a SPECTRUM dealer, you'll get **exactly the right Micro for your needs. SO LOOK OUT FOR YOUR SPECTRUM FACTS!**

After Sales care

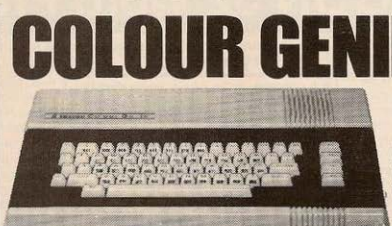
SPECTRUM service centres will ensure that should your machine 'go-down' **we will get it running again as quickly as possible.** We also offer **extended warranties** at reasonable prices too! – ask your **SPECTRUM HOME COMPUTER CENTRE** for full details.

COMPUTER DEALERS!

(or prospective Computer Dealers!) If you would like to know more about becoming a **SPECTRUM APPOINTED DEALER** on an **exclusive area basis,** please write to **MIKE STERN, Spectrum (U.K.) Ltd., Burrowfield, Welwyn Garden City, Herts.**

COLOUR GENIE

A truly reliable micro and highly recommended by Spectrum.



The new **COLOUR GENIE** features powerful and sophisticated **COLOUR GRAPHICS**, allowing you to create full 8-colour Games, Diagrams and Charts quickly and simply.

At its low **SPECTRUM** price, the Colour Genie is amazingly versatile – its **Powerful 16K RAM memory** (expandable internally to 32K) means **FULL COLOUR video games** and **POWERFUL COMPUTING** with a full range of inexpensive accessories: **16K RAM pack, Joysticks for TV games, Light Pen, Disk Drive** and a **Printer.**

But that's not all – the Colour Genie also features a **16K ROM Memory** with **128 Upper and Lower case Colour Graphics Characters** already stored, plus **sound**, a professional **typewriter keyboard.**

In use, it's as straightforward as any, thanks to the use of **BASIC** language and direct keyboard accessed **colour commands.**

The superb Colour Genie is at **SPECTRUM** now – check it out and see the Genius at work!

Spectrum LOW Price

£224.48 Inc. VAT

COLOUR GENIE ACCESSORIES	
Joysticks	£49.49
16K RAM	£38.50
Printer Interface	£39.95
VISCOUNT Teach yourself Colour Genie BASIC	£6.95

SPECTRUM FACTS	
Maximum user RAM	14,200 Bytes (approx)
Text Screen	24 x 40
High Resolution	160 x 96
Cassette Lead	Included

LYNX

Just look at this **super new LYNX Micro** – an **incredible 16K + 32K** video ram and that's **expandable** up to or beyond **96K.** For just **£225.00 INCLUDING VAT** the **LYNX** is **exceptionally versatile.** All **LYNX's** "add-on" connections are **standard types.** The **high definition colour graphics** make it a **top-value choice** for the **home or office** (with expansion, the **LYNX** can become an 80 characters-per-line word processor!) Take a look at the **LYNX** – a **memorable bargain** from **SPECTRUM.** But please phone to check stock position **before making a journey** as this new machine is bound to be in **great demand.**

Spectrum LOW Price £225.00

VISCOUNT – Teach yourself LYNX BASIC £6.95

SPECTRUM FACTS	
Maximum user RAM	13,700 Bytes (approx)
Text Screen	24 x 40
High Resolution	265 x 248
Cassette Lead	Included

ORIC-1

A superbly designed and engineered micro and great value-for-money from **SPECTRUM.** Offering **48K RAM Colour** – (8 foreground and 8 background can be displayed at same time) **High resolution graphics User definable Graphics. Full sound** (6 octaves of controllable sound.) **Easy to use keyboard** with **moving keys. Standard Centronics parallel interface allows** easy connection to a wide range range of printers etc.

Spectrum LOW Price £169.95 Inc. VAT

SPECTRUM FACTS	
Maximum user RAM	47,870 Bytes
Text Screen	28 x 40
High Resolution	240 x 200
Cassette Lead	Included

JUPITER ACE

Outstanding value-for-money! The **JUPITER ACE** uses easy to understand **FORTH** language. **Connects to your own TV. 3K RAM expandable to 19K. Full moving keyboard** with auto repeat and caps lock. **Full sound and chunky graphics.** If you've wanted to learn an impressive Language then this is the machine for you.

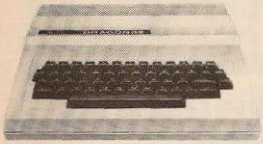
Spectrum LOW price £89.95 Inc VAT **£76.22** ex vat

SPECTRUM FACTS	
Maximum user RAM	1,000 Bytes approx.

Not all stores carry every advertised item, please phone before making a journey – Prices correct at time of going to press E. & O.E.

HURRY! Limited stocks only-

DRAGON



Unbelievable value at only £199.95 from **SPECTRUM**! British built and designed it's one of the **most impressive micros** to appear for quite some time. Extensive facilities include highly advanced colour graphics. Just look at this top specification: Powerful standard 32K RAM (expandable to 64K Bytes). ■ 9 Colour, 5 resolution Display. ■ Extended Microsoft colour BASIC (as standard). ■ Advanced sound with 5 octaves - 255 tones. ■ Professional style editing, e.g. extract line, auto find reinsert. ■ Professional quality keyboard. ■ Centronics Parallel printer interface. ■ Serious programmer/user - the BASIC on this machine is similar to that found on machines costing 3 times the price! ■ Uses almost any cassette recorder. ■ Standard file handling ON TAPE.

Spectrum LOW price £199.95 INC. VAT

SPECTRUM FACTS

Maximum user RAM	29,679 Bytes
Text Screen	16 x 32
High Resolution	256 x 192
Cassette Lead	Included

	EX VAT	INC VAT
ACCESSORIES		
Joysticks (pair)	£17.35	£19.95
Cassette Lead	£2.35	£2.70
CARTRIDGES		
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Cosmic Invaders	£17.35	£19.95
Meteroids	£17.35	£19.95
Ghost Attack	£21.70	£24.95
Cave Hunter	£17.35	£19.95
Starship Chamelion	£17.35	£19.95
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Examples from Dragon Manual	£6.91	£7.95
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Dragon Mountain	£6.91	£7.95
Typing Tutor	£6.91	£7.95
Black Sanctum	£6.91	£7.95

VISCOUNT Software for DRAGON Teach yourself Dragon Basic . . £6.95

Now with **48K RAM** and still at the same LOW price!

ATARI 800

Now this proven and tested machine has been upgraded to a massive **48K RAM** and it's still at the amazing **LOW** price of **£399.99** from **SPECTRUM**. It's an ideal Home Micro for graphics, educational and personal finance etc. use and it will take you from learning up to small business use. You can add printers, program recorders, disk drives and more, to expand your micro as and when you want, to suit your needs. So if you're looking for a top-of-the-line micro you must see the **ATARI 800** with **48K** at **SPECTRUM - NOW!**

Spectrum LOW Price £399.99 INC. V.A.T.

SPECTRUM FACTS

Maximum user RAM	37,899 Bytes
Text Screen	24 × 40
High Resolution	320 × 192
Cassette Lead	Needs own Recorder

ATARI 400

16K RAM

NOW ONLY £159.95 INC. VAT

BASIC cartridge extra

£39.99 inc. VAT

(£34.77 ex. VAT)

SPECTRUM FACTS

Maximum user RAM	13,323 Bytes (with basic Cartridge)
Text Screen	24 × 40
High Resolution	320 × 192
Cassette Lead	Needs own Recorder

ATARI DISK DRIVE £299.00 INC. VAT

ACCESSORIES, BOOK & GAMES for ATARI

	INC VAT
Accessories	
Thermal Printer	£198.95
16K RAM Pack	£65.00
400 Keyboard	£59.95
32K RAM board (400/800)	£75.00
48K RAM board (400/800)	£99.00
Paddles (Pair)	£13.99
Joysticks (Pair)	£13.99
I/O Cable	£12.99
Printer Cable	£28.50
Monitor Cable	£25.00
Thermal Paper	£4.00
Pointmaster Joysticks	£14.95
Quickshot Joysticks	£14.95
Keyboard for Atari 400	£00.00
Books & Manuals	
Wiley Manual	No VAT
Basic Reference Manual	No VAT
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Home Computer Programs - Home/Office	
Word Processor (Disk)	£99.99
Mortgage & Loan	£14.99
Microsoft Basic (Diskette)	£59.99
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INV. to programming 1	£19.99
INV. to programming 2	£22.99
INV. to programming 3	£22.99
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Hangman	£14.99
Kingdom	£14.99
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Commodore VIC-20

Now a top quality home/business micro for the price of a games machine.
■ Memory expandable to 32K ■ High resolution (full PET type) graphics ■ 16 Screen colours and 8 border colours ■ Plugs in to your TV, or monitor ■ Add Disk Drive & Printer for impressive 170K Byte system ■ Can act as an intelligent terminal for a larger computer.

£129.90 INCLUDING VAT

SPECTRUM FACTS

Maximum user RAM	3,853
Text Screen	22 x 23
High Resolution	176 x 158
Cassette Lead	Needs own Recorder

VISCOUNT SUPER X2

64K DYNAMIC RAM PACK for VIC-20

EXCLUSIVE TO SPECTRUM!

Unbelievable-but-true, now you can up grade your VIC-20 from 3.5K to a massive 67½ RAM. Enables you to load up to 8 games or programs at a time & still select which one you wish to use. Can be used in conjunction with other expansions to increase total memory up to 152K-using the VIC memory expansion board. The SUPER X-2 will make your VIC-20 the biggest little micro in town!

Spectrum LOW price £114.94 INC. VAT

COMMODORE 64

Very limited supplies of this new micro now available - please check with your local SPECTRUM dealer before making a journey.

Spectrum LOW Price £345.00

TEXAS TI99/4A

■ 16K RAM (expandable to 48K) ■ Built-in 14K Byte BASIC interpreter ■ 16 Bit Micro-processor ■ 16 Colour High Resolution graphics ■ Extensive range of solid state software command modules available from games to architectural aids.

Spectrum LOW Price £154.95 INC VAT (£134.74 ex. VAT)

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Cassette Lead	Extra £10.95

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Munchman	£23.43	£26.95
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spectrum

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Kickback	£29.84
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Darts	£19.49
Snooker & Billiards	£19.49
Pool	£19.49
Cribbage & Dominoes	£14.89
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Mutant Herd	£24.25
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River Rescue	£25.24
Vic Music Composer	£25.24
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Rabbit Functions	£4.49
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KUMA

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Adventure	£12.08
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Monster Mine (for Dragon)	£7.95
Space Mission (for ZX 81)	£4.95
Space Mission (for Spectrum)	£4.95
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Spiders of Mars	£19.95
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Bonzo	£7.95
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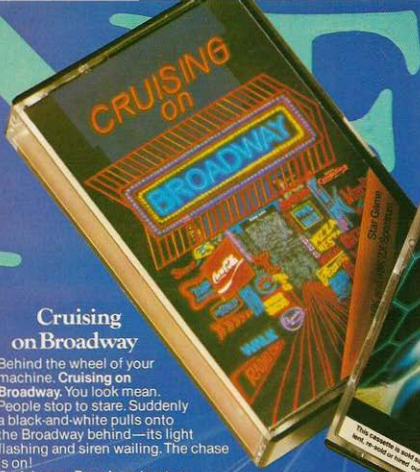

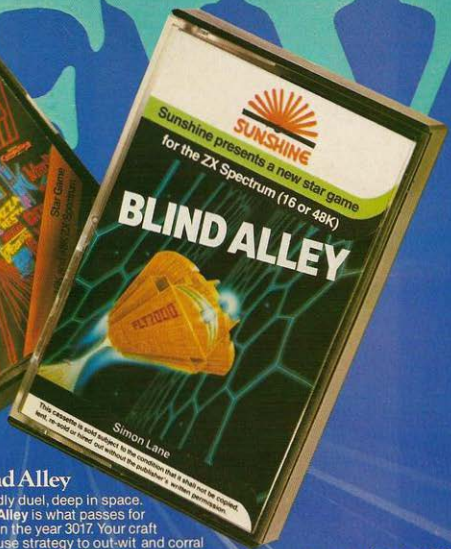

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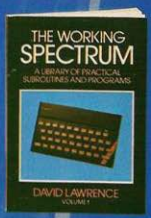

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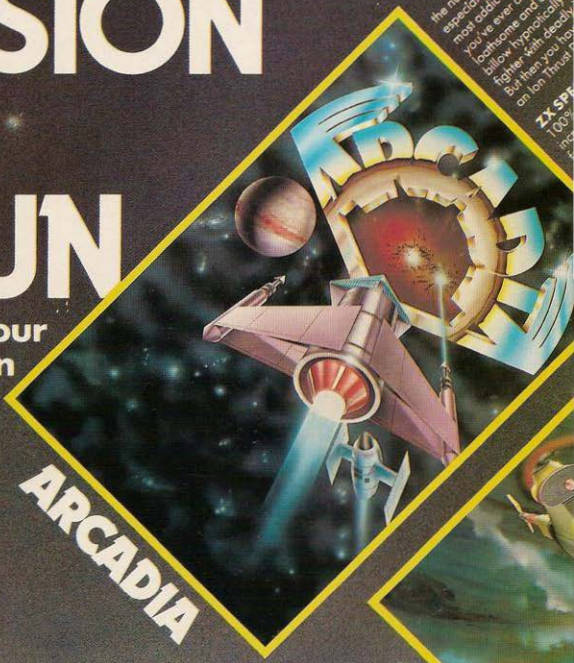

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But then you
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But they didn't say I'd have to stop and control 'not' just one but two
or even more garbage pods. Then prod them, push
them, toward that black hole, and oh, it's so very, very
black, and so lonely, so empty.
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No way out, nowhere to hide, on my own, my own, own.
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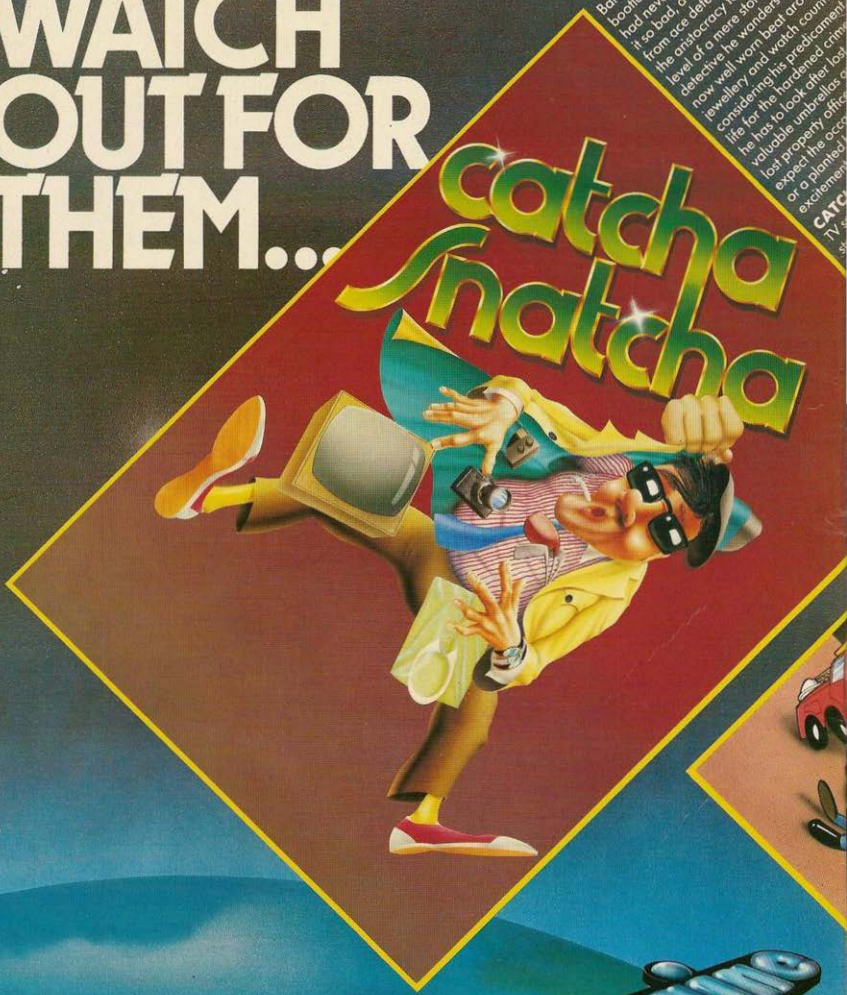

Imagine

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A SNATCHA brings to your
een the mad, mad world of the
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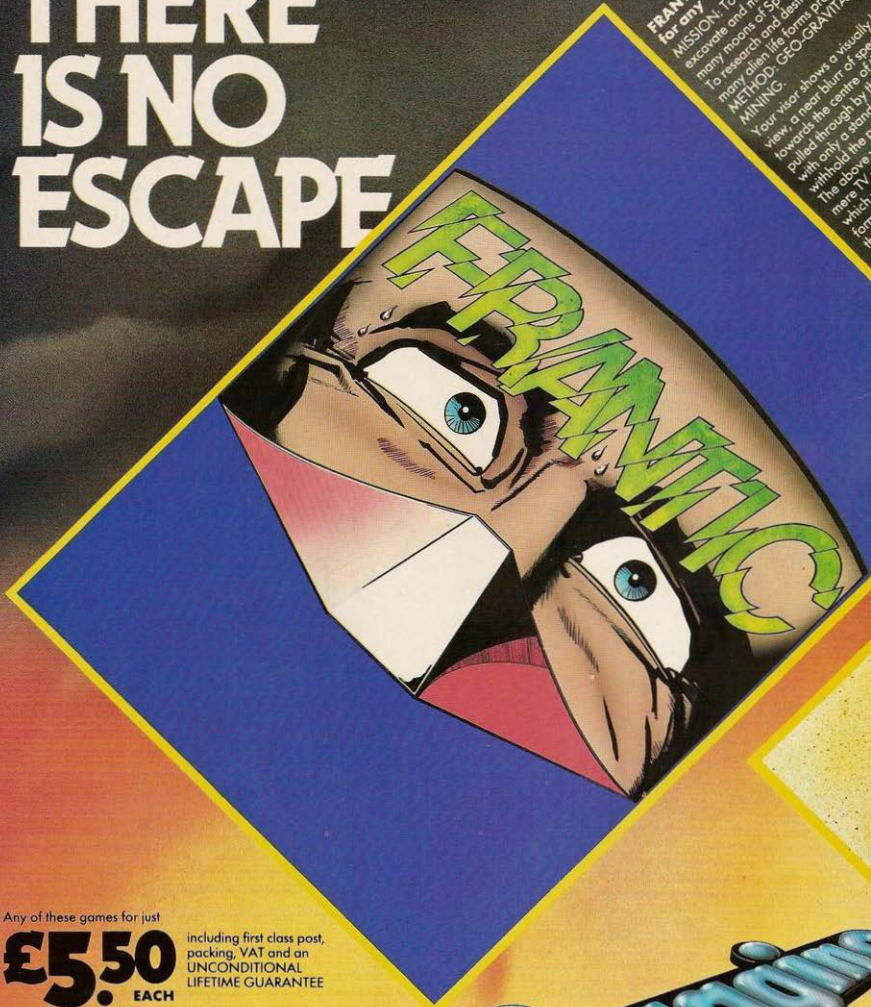

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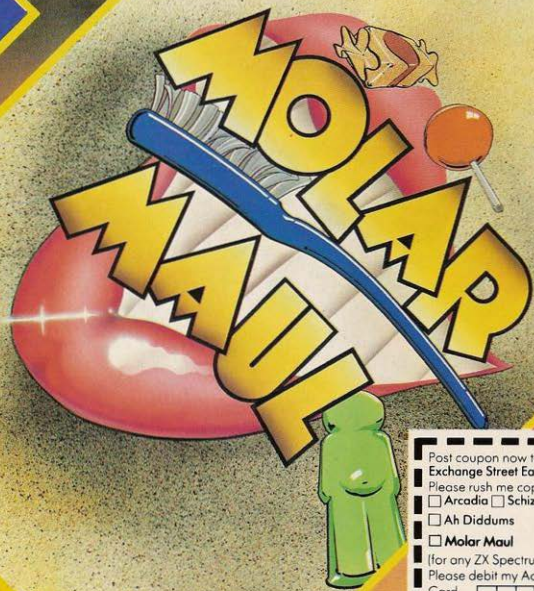

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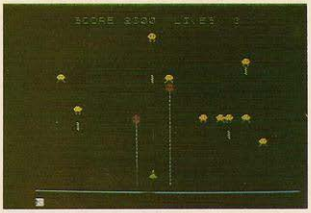

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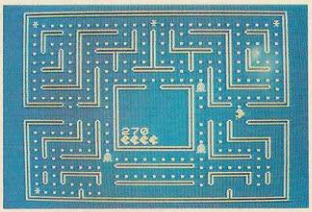

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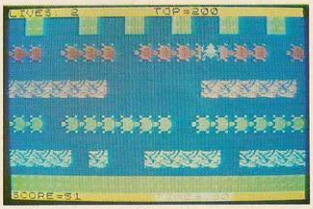

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YOUR LETTERS

THE CASTLE OF RIDDLES

At last the task is finished — Castle of Riddles is solved! Although it undoubtedly took me longer than many others, I posted my competition form earlier this morning. I also felt the need to make a few comments.

I am not an adventure game expert by any means, Castle of Riddles was the first I have ever completed, but what a marvellous five days' enjoyment I have had. A thoroughly well-planned and written program with only one exception which I will come to in a moment.

I would never have believed the incredible emotional ups and downs a game like that could produce. From Saturday morning to evening, passing the Shooting Gallery or the Awesome Creature was proving absolutely impossible. That was a low low. My wife encouraged me to take a break and relax. A few hours later the thought of exploding the case and scaring the Giants seemed a possibility. Sure enough that was a high. Later in bed, amid a turmoil of thoughts, the association between the red paint and the creature occurred.

On Sunday morning with trembling fingers, I threw the can of paint and observed with undisguised joy the dying of the beast. That was a high high.

The one odd thing about the program was the Black Rod. I just could not believe that losing the rod before moving through the Black Passage was correct. I tried for a long time making the trip from the Pit through the tunnel the final move, but that of course proved impossible.

Although the right answer is achieved by not carrying the rod through the passages, surely there must be a way of retrieving it first? I would very much like to know.

However, congratulations to *Your Computer* and Acornsoft for mounting a brilliant exercise, I sincerely hope that it will not be the last.

P Croft, County Down, Ireland.

SCROLL TRICK

A feature lacking on the Sinclair Spectrum is the Scroll command. Although substitutions have been published for this, involving Poking and Printing, I believe that my solution is much neater. Simply, place the line, LET A=USR 3280 in your program, and the entire screen will be scrolled up by one line.

Peter Bernstein, Northwood, Middlesex.

POLYGON BUG

The Sinclair Spectrum has a versatile bug in the one-liner

```
PLOT x,y : DRAW a,b, n*PI
```

There is a pentagon at x=y=a=b=50, n=100.8. Odd-sided polygons are usually larger than the circle whose diameter is defined by the line joining x,y and x+a, y+b. Thus they go off the screen, with an Integer Out of Range message. Good examples are the near-perfect triangle spooking about at x=220, y=210, a=b=50, n=168.24, and the heptagon lurking somewhere betweeen n=71.5 and 72.5.

The bug crawls in at n=17 and is cyclic. As odd values of n go up, the circle turns into an apparently rotating polygon. As n rises, the number of sides decrease and the speed of rotation increases, program running time stays constant at eight or nine seconds.

At some point it collapses into a rotating line. I think most of these collapsed polygons are at non-integer values of n. As n increases further the polygon "opens out" and the number of sides increases. The cycle then repeats. For polygons and stars, the trick is to find values of n that visually "locks" the rotation and gives a static shape.

I recommend trying small values for a and b in studying the odd-sided polygons, so that they stay on-screen even if they are very large relative to the circle diameter. I cannot: my Spectrum recently went into terminal coma and is back at Chateau Sinclair for a rebore!

John Brazier, Stanford in the Vale, Oxfordshire.

LYNX FAN

Your review of the Lynx in your February issue prompts me to reply to some of Bill Bennett's comments: He opens his review with the assumption that the consumer wants gimmicks or a computer with some outstanding feature. Any prospective Lynx buyer should bear in mind that some machines with outstanding features have then at the expense of some graphics. If anyone wants gimmicks, I suggest that they compare the Spectrum dead-flesh keyboard with that of the Lynx.

As a ZX-81 owner I know that Sinclair's manual provides one chapter of two pages on machine-code. The Lynx manual's machine-code chapter is nine pages long. I do not think any purchasers can expect a great deal more.

Your reviewer seemed to be disappointed by the Beep command — perhaps he is jaded after all the machines he has reviewed. Anyone wishing to try out Beep need only walk into a branch of Laskys and type in the following ditty:

```
 90 RANDOM
100 LET W=RND(200)
110 LET C=RND(200)
120 BEEP W,C,63
130 IF W C THEN LET W=W/2
140 IF W=C THEN GOTO 90
150 GOTO 100
```

Our 15-month-old daughter thinks that this beats Beethoven.

I agree that the manual could be improved by the addition of an index — I am sure it will be.

Why was there no mention of the Lynx's ability to accept abbrieviated commands? For example, Auto to A. Also, why no mention of single key entries? I think that indeed the Lynx does indeed offer something new — it is consistently good. It is soundly engineered and it does not overheat. It has a well-designed, professional quality keyboard, and it is British and available.

No doubt by now you have guessed that previously I had been using a ZX-81 and now am the proud owner of a Lynx. Before buying it I looked at the BBC machines. You have to pay another £195 to implement CP/M on the BBC. I personally did not like the Dragon as it was not Z-80 based. Following my bad experiences with mail order from Sinclair, imagine the trepidation with which I ordered my Lynx on November 22, 1982. I had hoped to receive it before Christmas but did anticipate some delay with a brand new machine. Imagine my surprise when I received a letter of apology in the New year apologising for the delay and promising it by mid-January. Sure enough it arrived on January 20. Considering the Christmas holiday I do not think that is a bad record.

I wanted CP/M because I had used WordStar at work and appreciated what a vast range of software would be available to me given that disc-operating system.

R D Hughes, Worthing, West Sussex.

NO STRINGS

Mr Excell seems to think BBC Basic is more standard than Sinclair Basic because BBC Basic supports string arrays — Letters, January issue, p27. In fact, those funny Mid$, Left$, Right$ and similar commands are an aberration of Microsoft-type Basics, and not "standard" at all.

The proposed American National Standards Institute — ANSI — committee X3J2 is currently finalising Standard Basic. It does not include string arrays, and it does make Let mandatory. The original co-author of Dartmouth Basic, and Chairman of the ANSI committee, noted last year that string arrays had gone and cried "Good riddance!" I agree.

Anything that can be done with string arrays can be done with long strings, but not vice versa. Also, string arrays are not a feature, in the Microsoft form, of any more advanced language I can think of. If you want to progress from Basic, it is not a good idea to come to depend on them.

Mind you, I would rather use BBC Basic than Sinclair Basic. BBC Basic is good, but look at the size of it! A better Basic is the Cromemco Struc-

DUTCH DRAGON BOOSTER

With reference to Stephen Mummery's letter — February 1983 — regarding the increase of the Dragon 32's user-available memory, I can add that with the following statement:

```
POKE25,6:POKE27,6:
POKE29,6:POKE31,6
```

you have 31015 bytes at your disposal. You have also cleared the first high-resolution page, which could not be done with the PClear statement. With Clear0 you can add another 200 bytes.

Another useful feature, which you can achieve by changing pointers, is to Merge programs. First you have to Cload the first program. Then you ask the contents of memory locations 25,26,27 and 28 with the command:

```
?PEEK(25),PEEK(26),
PEEK(27),PEEK(28)
```

Next you have to Poke the value of location 27 in location 25 and the value of location 28 minus 2 in location 26 — suppose the value is 137, then you have to Poke value 135 in location 26. If the value of location 28 is 0 or 1 then you have to subtract one from the value to Poke in location 25 and the value to poke in location 26 would be 254 or 255. Now you can Cload the second program. Make sure that all the line numbers are greater than those in the first program. That can be done by the Renum command. The last thing to do is to Poke the original values back to location 25 and 26, which will be in most cases 30 and 1. If you enter the List command you see you have both programs together.

T A Bik, Amstelveen, Netherlands.

tured Basic, which also lacks string arrays, but that's 32K. We should all have so much spare memory.

I own an Atari 800. Atari Basic is a stripped-down version of the Cromemco Basic, written by the same people. It takes up only about 8K, and has long strings instead of string arrays. As it is supplied on a plug-in ROM, however, you can remove it and load an enhanced Microsoft Basic — that is more than twice the size — from disc without running out of memory. Alternatively there is an enhanced version of Atari Basic called Basic A+, available from Optimized Systems Software. Again it was written by the people who wrote Atari Basic, is upward-compatible, and includes the things that had to be left out of the 8K ROM such as Print Using, While — Endwhile, and If — Else — Endif.

The moral is simple. The most powerful feature to look for in a Basic is that you can remove it, or switch it out, freeing the address space either for another Basic or another language.

Jack Schofield
London W3

SPECTRUM TIPS

Here are a few tips for increasing execution speed when writing programs in Basic on the Spectrum. A program's memory may be divided into three parts: the top, the middle and the bottom, each one being more appropriate for the storage of a specific functional part of the program.

The top part, which always has the lowest line numbers, is suitable for frequently-used loops and subroutines — the most-used ones have the lowest line numbers. It is useful to make a subroutine with any frequently-used loop — having taken all unnecessary computations out of the loop — and then put it at the top of the program's memory. It is still better to pack each subroutine within one line only, keeping in mind however that For-Next loops are better at the beginning of a line instead of in the middle. The middle part is used to store the main body of the program.

The bottom part is convenient for functions that are performed only one time per execution, like initialising variables, dimensioning arrays, reading Data statements and so on. It is better to declare variables beginning with those most frequently-referenced first.

The reason for all that is that jumps are always performed by processing through line numbers, starting at line 1, and skipping over to the next line until match is found; thus, the fewer lines away from line 1 you are, the quicker the jump. Do not forget that this gain is multiplied by the number of jumps performed: in French, we say: "Les petits ruisseaux font les grandes rivières"!

André Didelot,
Geneva,
Switzerland.

EDITORIAL

AFTER THE RAVAGES of glue sniffing and teenage alcoholism, the nation's youth are now in the grip of computer addiction. Recent shock reports tell how children sneak back after four o'clock to use their school's computer laboratories, or meet in derelict buildings to program pocket calculators. Parents are warned of the tell-tale signs: the inability to converse in anything but machine code; the complexion horribly coarsened by hours at the keyboard; the eyes vacant except for the cursor flashing in the corner.

Clearly all this makes for good, scare-mongering newspaper stories which are, of course, totally misinformed. Every computer fan knows that you are just as likely to observe this kind of behaviour in adults as in children. A recent survey by Gowling revealed that the father and son partnership makes up 80 percent of home computer owners. Micros are bought for sons by fathers who believe that understanding computing will help their child in school. Presumably as soon as the micro arrives at home some children become users very quickly. In other cases, the father feels he has to get to know the machine if he is to help his son — and becomes hooked in the process. So, what seems to distinguish this addiction from other vices is that parents and children are equally responsible for introducing each other to it. But what is it about computers that makes them so habit-forming?

Some will claim it is the element of problem-solving involved in programming. Others will answer that it is the fact that micros promise mastery of a finite and logical universe contained in a small plastic box. A place where — unlike the real world — if you have the knowledge, what you want to happen surprisingly often does. In other words a kind of hi-tech escapism. Others, still under the influence of a dose of Space Invaders, will be unable to answer at all.

In the old days lecturers complained that all-night drinking and debauchery disrupted students' studies. Now a new villain has emerged. Tutors at London University claim that many undergraduates are spending five hours a night intoxicating themselves with the pleasures of home computing. Students arrive for their lectures fit only for another game of Pac-Man.

So much for the vices but what about the virtues of computer addiction? A physical dependence on micros could make you highly productive — if only in terms of computing. Jobs that can only be regarded as chores by the ordinary owner are fun for the addicts, who see in every new operating system the chance of a kind of electronic nature ramble.

The computer-dependent form an unpaid army of software engineers ready to engage themselves in any national programming cause that appears on their screens. It is exactly because there is this level of obsessional commitment to home computing that such a profusion of software exists in the U.K.

Kids have been addicted to arcade games for 30 years. But whereas the teenage pinball wizards of the past only profited the pier manager, today's silicon whizz-kids are learning skills which could stand them in good stead for their future careers. Some already have careers, programming for the big software houses.

And although critics view the addiction as dangerous, the bank managers of the child prodigies may well be content to see them continue living dangerously.

How to write for *Your Computer*

We called this magazine *Your Computer* precisely because we welcome your views, tips and hints and even your criticism of machines and software in general. If you would like to see your name in print, whether on a Software File program or a full-blooded article, here is how to go about it. Ideally, all articles should be typed double-spaced on one side only of uniform sheets of paper. If listings can be dumped directly from a printer — you can always use a friend's or user group's — this minimises the risk of error. In a perfect world a cassette would accompany the article. That considerably speeds up the checking process. Not only do you get to air your own discoveries and opinions, but we will even pay you for the privilege. We pay £35 per published page — that's as it appears in the magazine and includes illustrations.

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Editorial: 01-661 3144
Your Computer, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.
Subscriptions: U.K. £8 for 12 issues.

ABC

Printed in Great Britain for the proprietors of Business Press International Ltd, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. Tel: 01-661 3500 Telex/grams: 892084 BIPRESG. ISSN 0263-0885. Printed by Riverside Press Ltd, Whitstable, Kent, and typeset by Instep Ltd, London EC1.

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Happy birthday Microdrive — and now a big hand for the ZX-83, ZX-84 and Microvision

YOU WILL be able to order the Microdrive on or about April 23 — the anniversary of its official announcement. Sinclair also has a ZX-83 in store for us this year, but the revolutionary all-in-one computer exclusively revealed in last November's *Your Computer* is now dubbed the ZX-84 and may not be released until next year.

Sinclair's long awaited Microdrive is a compromise between cassette storage and floppy-disc storage. A high speed tape loop — or stringy floppy — will store over 100K of data or programs. Sinclair is confident that the access time will be less than the 3.5s. advertised.

The £40 prices is less than originally expected but a £30 drive controller containing an RS-232 interface is necessary to connect the Microdrive to a Spectrum.

Initially Microdrives will not be able to run on any other computers, although one controller will allow you to run up to 40 Microdrives off one Spectrum.

The Microdrives will accept interchangeable tape-loop cassettes. Initially Sinclair will sell games and adaptations of existing Spectrum software on these cassettes. Blank cassettes will be made available to other software manufacturers.

Priority will be given to satisfying the Microdrive orders of these who ordered Spectrums last summer, so it could be late this summer before the microdrive goes on general release.

Sinclair's Microvision flat-screen pocket television should be launched this July, opening the way for the 9in. flat-screen to be incorporated in the ZX-84, which will also have twin Microdrives and a Modem.

Nigel Searle, Sinclair Research's Managing Director is playing his cards close to the ZX-83, but he has confirmed that there will be one — "It is fairly natural if you follow the sequence: ZX-80, ZX-81, Spectrum — alias ZX-82".

Your Computer spies have observed several projects which could be the ZX-83 under wraps at Sinclair's new Cambridge headquarters. One of the favourites is a Spectrum with improved sound capabilities and a Modem which could be rushed into production if the Oric begins to threaten Sinclair's hold on the market.

The situation is further confused by the low-cost desktop business computer which Sinclair has developed for ICL to launch this year.

YOUR COMPUTER TOP 20

Game	Company	Machine
■ Arcadia	Imagine	Spectrum
■ Chop Liter	Creative Software	Vic-20
■ Defender	Atari	Atari
■ Dragon Trek	Salamander	Dragon
■ Flight Simulation	Psion	ZX-81
■ Football Manager	Addictive Games	ZX-81
■ Gorf	Commodore	Vic-20
■ The Hobbit	Melbourne House	Spectrum
■ Hungry Horace	Psion	Spectrum
■ Intro to Programming	Commodore	Vic-20
■ King Kong	T D Software	ZX-81
■ Miner 2049er	Big 5 Software	Atari
■ Monsters	Acornsoft	BBC
■ Pimania	Automata	Dragon
■ Planet Invasion	Microdeal	Dragon
■ Planetoids	Acornsoft	BBC
■ Rocket Raid	Acornsoft	BBC
■ 3D Defender	J K Greye	ZX-81
■ 3D Tunnel	New Generation	Spectrum
■ Timegate	Quicksilva	Spectrum

The difference between an Apple and a Peanut is just £300

THE APPLE II costs £675. From mid-April Peanut Computers will be selling an Apple look-alike with virtually the same specifications at just over half the price.

Like the MPF-II, another Apple copy, the Peanut is imported from the Far East. It is designed to run Apple software and to take many of the large range of Apple II accessories. These include RAM expansion boards, Z-80 interface to allow the computer to run CP/M software, language cards and an 80-column display card.

The standard machine comes with 48K RAM and is expected to sell for around £345. Two graphic modes are offered, giving a resolution in black and white of 280 by 192 and colour resolution of 140 by 192. The text format provides 40 columns by 48 rows. It will be sold by mail order from Peanut Computers, Unit 20, Low Mill, Dewsbury, West Yorkshire.

The Apple II E — Apple's latest attempt to stave off Apple II copies.

Just propping up the back of your home micro can save it from overheating and certainly makes it easier to type on. While most computerniks lean their slices of 1980s high technology on cassette cases, door wedges or stale sandwiches, Hi Stak plastic legs are the latest spring fashion. Warp Factor Eight sells them at an appropriately astronomical £3.95 for two. If you use something really obscure to prop up your micro, write in and tell us and we will send you a pair of Hi Staks.

Check your power packs

SINCLAIR RESEARCH has been obliged to recall some 28,000 power packs after discovering that they could be dangerous.

The power packs are recognisable by a white stripe on the power supply's output to the Spectrum.

What makes them unsafe is that the 240V input track inside the power supply is too close to the 6V output — it is possible that a power-spike during very humid weather could result in a user receiving an electric shock.

Sinclair Research Managing Director Nigel Searle admitted that the power packs — just one batch from one supplier — were not checked in detail for safety.

BBC Micros for the blind

A GRANT worth £18,000 from the Department of Industry will help the Open University to open up microcomputing to the blind and partially-sighted. Eight schools will be supplied with "touch and hear" systems based on BBC Micros equipped with speech synthesisers.

The system reads lines of Basic aloud as they are entered using a Votrax-based Type and Talk synthesiser instead of displaying them on the screen. So instead of, say:

```
10 PRINT CHR$(23)
```

appearing on the tube you would hear

```
TEN PRINT CHARACTER
TWENTY-THREE
```

Many blind people cannot use a conventional typewriter keyboard but are familiar with a manual Braille typewriter, the Perkins Brailler. So Dr Thomas Vincent and his Manchester Open University team which has been developing the system over the last year has adapted the Perkins machine as an alternative keyboard for the BBC Micro by fitting microswitches to sense key depression and an interface to the BBC Micro.

Vincent hopes that the micros will stop the blind children from being left behind as computer skills become more widespread. It should also make it easier and more enjoyable to learn Braille.

Versatile new portable from Texas completes the TI family

THE STRUGGLE to win a place in the nation's briefcase becomes even more heated with the launch of the Compact Computer 40, the first in a series of Texas Instruments portable computers. Texas clearly intends it to compete with the Epson HX-20.

Like the Epson computer it has an liquid-crystal display , a QWERTY keyboard and a numeric keypad. The display has 31 characters, can be scrolled left and right and adjusted for different contrasts.

Measuring 9in by 6in, by 1in, the CC-40 weights 22oz. and takes four AA alkaline batteries which provide power for up to 200 hours. Programs are retained in memory when the machine is switched off.

Memory capacity is 6K of RAM expandable to 18K, and 34K ROM. Plug-in cartridges can expand the ROM by a further 128K. The Basic is compatible with the TI Basic used in the TI-99/4A and the new TI-99/2 announced last month.

The CC-40 will also take the same low-cost peripherals as the TI-99/4A. These include a £150 four-colour printer and the £120 Wafertape digital tape drive which takes 40K tape cartridges and has a data-transfer rate of 8,000 bits per second.

A RS-232 interface will also be available and at later date Texas will release other peripherals such as a Modem, a bar-code reader and a TV interface.

The CC-40 is expected to sell for around £170. Texas claims that it has more capabilities than the Epson portable computer and that it will be considerably cheaper — even with the additional cost of the printer and tape drive.

Double Dragon will answer the 64,000 byte question

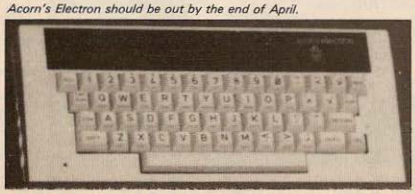
WATCH OUT Commodore and BBC, Dragon Data plans to launch a new 64K RAM machine late this summer. The £180 Dragon 32 which has now sold 35,000 units will not be discontinued when the £300 64K machine goes into production.

Commodore at least will be well able to drop the price of the Commodore 64 if the competition gets too hot. A spokesman refused to deny persistent rumours that new technology makes the £350 64 cheaper to produce than the old £130 Vic-20 and would only say that price was "all to do with what the market will bear — not to do with what it costs to make".

Cut-price rail tickets offer for first Midland Computer Fair

WHISPER IT softly but Acorn's Electron may receive its first public showing at the Midland Computer Fair — and combined rail fare and admission tickets will cut the cost of getting there.

Acorn's Electron should be out by the end of April.



Tens of thousands of home computer enthusiasts are expected to turn up to the Fair at Bingley Hall Birmingham which will be open from 10am to 6pm on Thursday and Friday April 28 and 29, and 10am until 5pm, Saturday April 30.

Admission will be £2 — half price for children and pensioners — but British Rail and IPC Exhibitions are offering cut-price all-in fares; such as £12 from any station in London, £9.50 from Manchester, £4 from Coventry and £4.50 from Hereford.

Not some new video-game monster but a face which may be just as frightening for some of the big names in micro games. It belongs to Richard Branson who made millions from Virgin records and is now turning his evil eye to home computers. Nick Alexander will run Virgin Games which will bring record-company style razzmatazz to computer games. Nick Alexander reckons that computer games will soon become even more popular than video films.

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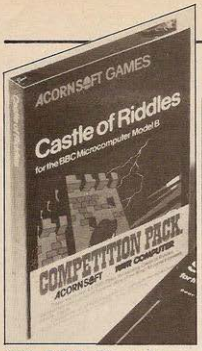

£3,000 Riddle — the winners

NOW IT CAN be told — the names of the winners of the *Your Computer* and Acornsoft Castle of Riddles competition. Peter Voke from Aylesbury, Buckinghamshire was the first to deliver the right answer, in person.

Second was C P Bignell of Littlehampton, West Sussex and, in third place, P K Colbert of Heath, Cardiff. Next month, we will publish fuller details for those of you still stuck in the Pit or over-awed by the Awesome Creature.

Down with the Atari 400

ATARI IS LAUNCHING a three-pronged attack on micro users. Prices of the 400 series home computers have been slashed by £40 to £160 for the bare 16K RAM machine or £200 if you want Basic and the manuals. Meanwhile the £400 Atari 800 has been upgraded from 16K to 48K RAM without a price increase and a conversion kit will soon be available to turn the Atari video games machine into a home computer.

Maestro and Renault II pop talking micros under the bonnet

AT LAST motor manufacturers are waking up to the possibilities of on-board microcomputers. Computers have been creeping into luxury cars like BMWs for the last couple of years but only with the announcement of the Renault 11 and the Austin Maestro last month has the micro appeared in volume production.

The Austin and Renault systems are a similar size to the average home computer with the addition of a voice synthesis unit which again is similar to some of the plug-in peripherals available for home computers. The Maestro's unit is based around a 6805 microprocessor running at 4MHz. 32K ROM is used to store 15 phrases such as "Fasten your seat belt" including warnings of high engine temperature or low fuel.

In Britain the voice is female but a further 128K ROM on export models incorporates German, French and Italian voices. The French have also opted for a female voice but the Germans and Italians will be warned by male voices. The Germans will be confronted by a barking "Achtung, achtung", every time they step out of line.

Renault has opted for a similar voice unit on the Renault 11 — a fastback version of the top-selling Renault 9. A female voice will regale the driver with advice while a male voice will shout warnings.

The Maestro's voice unit will only be available on the top of the line Vanden Plas and MG models but the microcomputer will control speed and temperature sensors on all models and will power a digital display board. Smiths Industries who makes the unit claims that the vacuum fluorescent display of speed and fuel consumption is 20 times brighter than a television screen.

Austin's Maestro — below — and the Renault II — above.

Computer garages to fix micros on the spot

HIGH STREET computer garages where you can take in an ailing micro and have it fixed on the spot for a fixed fee of £10 are the latest idea from Liverpool software house Imagine.

Sending your home computer back to the manufacturer after it gives up the ghost in the middle of a game of Pac-Man can be a frustrating business. With horror stories of people waiting up to a year for repaired machines to be returned, Imagine's Mark Butler is confident of the demand for a simple High Street repair service.

The first computer garages will appear in Liverpool but Mark Butler is already negotiating with an Oxford Street store and hopes to set up branches all over the country. The garages will deal with Spectrums, ZX-81s, BBC Micros, Dragons, Vic-20s and Atoms.

Previously Imagine was better known for games like Wacky Waiters and Ah Diddums but although Butler claims that 70 per cent of Spectrum owners now have Imagine's Arcadia, it has not starred in *Your Computer's* retail Top 20 because most of the sales have been by mail order.

Now you can plug your Spectrum straight into a professional printer using the new Euroelectronics ZX Lprint Centronics interface. This parallel interface will free Spectrum owners from dependence on Sinclair peripherals and will be tough competition for Sinclair's serial RS-232 interface which should be launched this month. Both the ZX Lprint and Sinclair's RS-232 should cost around £30.

Bob Dickens of RD Labs has had to head for the hills because of Your Computer. *Sales of the Digital Tracer — a device which allows you to copy drawings straight to the screen with a Spectrum or ZX-81 — have proved so successful since we reviewed it in January that RD Labs has had to move to a new factory in Cwmbran, South Wales.*

VOLCANIC DUNGEON CHAMPIONSHIP

CARNELL SOFTWARE

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VISIT THE AMAZING NEW EPCOT CENTRE

Volcanic Dungeon, the addictive adventure. People have been known to venture into its maze of caverns to rescue the Princess Edora again and again. If you are one of them, or wish to be, then you could find yourself lying on a **sun-drenched beach in Miami for a week. Followed by a further week at Orlando**, visiting **Disney World** and **Epcot**. So what do you have to do for all this? **Just be the best Volcanic Dungeon player in the UK, that's all!** Ten finalists will battle it out in the championship at the London Computer Fair, Earl's Court, in June 1983. **But first you must prove you are worthy.**

Volcanic Dungeon is available on the **16K ZX-81, 48K Spectrum and Dragon 32**. An entry form is supplied with every game. (Anyone who already owns the original ZX version can enter by sending a SAE for an entry form.) **Order your copy NOW** from **CARNELL SOFTWARE, 4 Staunton Road, Slough, Berks. Only £5.00** including P&P. **Also available from good microcomputer stores.**

The Judges' decision is final and no correspondence will be entered into. All business associates of Carnell Software, and their relatives, are disqualified from entry. A copy of the rules of the Volcanic Dungeon championship will be supplied with the entry form.

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ZX SPECTRUM: 16/48K

Our latest Top 10 Programs for your Spectrum. They run on both 16 & 48K.

3D TUNNEL Brilliant NEW 3D graphic game by Malcolm "Escape" Evans. Fly down the winding 3D tunnel shooting bats, spiders, frogs and rats! Demo mode: 3 speeds: training program for each phase. And (48K only) watch out for the Tube train! (New Generation) £5.95

3D TANX NEW game with stunning graphics. Shoot the enemy from your 3D tank turret. 3 play levels: accurate ballistics: 1 or 2 players: hold feature: demo mode: training program. And choose your own control keys: even plays 'God Save The Queen'! (DK'Tronics) £4.95

WINGED AVENGER *"One of the best...covers all the stages of the arcade original...a game to come back to." Pop Comp Wkly.* Very fast 'PHOENIX'. 7 play levels: 3 attack waves: laser shield: mothership with smart bombs. (Work force) £4.50 (16K ZX81 version. £4.50)

GROUND ATTACK *"Best Spectrum version of the arcade game" Yr Comp "Very absorbing" E&C "Extremely good" Pop Comp Wkly.* Thrilling SCRAMBLE'. Pilot your ship thro' 26 zones: up, down, brake, thrust: smart bombs: as you get better, it gets harder. (Silversoft) £5.95

CENTIPEDE The first - and fast - Spectrum version of the famous arcade game. Full arcade movement - left, right, up, down, fire - as you attack the centipede. Great graphics. Watch out for the jumping spider! 3 lives: hold feature. (DK'Tronics) £4.95

ESCAPE *"One of the best and most original games we have seen" S User.* 5 very real dinosaurs chase you round the maze as you search for the axe to escape. Different maze every time. 5 play levels: 9 speeds: Hall of Fame. (New Generation) £4.95

GULPMAN *"The one cassette that I would buy...an exceptional program." Pop Comp Wkly* 15 mazes, each with demo mode: 9 speeds: laser gun helps against 4 chasers. Program your own control keys: personalise/save your very own game. (Campbell) £5.95

COSMOS NEW! Fantastic graphics. Loads in 2 parts (instruction manual first). Protect your 9 ships against 18 aliens, warp mines, asteroids. Your graphic on-board computer helps with elaborate displays. Our favourite new game. (Abbex) £5.95

FAUST'S FOLLY The first adventure we've seen that's worth playing in 16K. It's great and it's got graphics! Loads in two parts: clear instructions first. Then a smashing adventure with directions, inventory, look, score, save. Amazing! Abbex) £5.95

OTHELLO *"Recommended without reserve...a superb opponent" Yr Comp.* The great 19th Century power game. Surround your opponent: capture his territory. Millions of different games: maximum 60 moves each. 1 or 2 players: demo game: 9 skill levels: print. (Mol) £7.95

ZX81 OWNERS!

Special 16K ZX81 versions of 6 of these programs are available:

WINGED AVENGER	**£4.50**	**PIMANIA**	**£8.00**
OTHELLO	**£6.95**	**CHESS 2**	**£9.95**
BLACK CRYSTAL	**£7.50**	**GREAT BRITAIN LTD**	**£4.95**

Use the coupon to order. Free detailed catalogue of our best ZX81 games with every order. Or send large SAE for catalogue only.

48K SPECTRUM ONLY

These programs use nearly all the Spectrum's 48K. They will not run on the 16K Spectrum. But there are versions of Black Crystal, GB Ltd, Pimania and SpecChess for for 16K ZX81.

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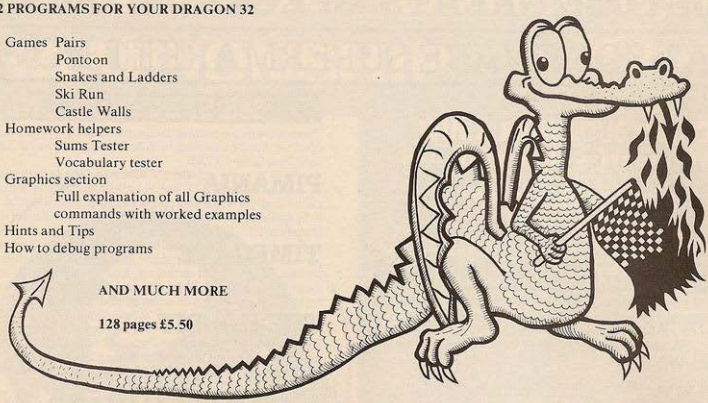

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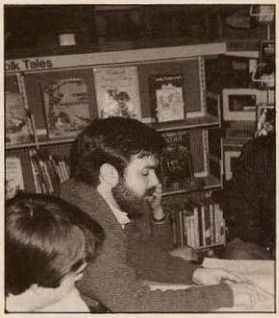
Computer Club is here to encourage you to start your own local computer club or, if one already exists, to join it and become involved. We would like to hear of anything which has made your club a success, or of any projects or programs you are developing.

Camden keys in at Queen's Crescent

Meirion Jones takes a look at what's happening down in North London at the burgeoning new club based at Queen's Crescent library in Camden.



WHILE ANNA FORD, David Frost and the rest of TV-am's megastars were launching themselves from Camden Lock on to the nation's breakfast tables with a "Hello, good morning and welcome" a quieter but perhaps more effective launch was being prepared down the road at Queen's Crescent library.

It all started with a chance enquiry by Wil Jackson at his local library. Why, he wanted to know, did they have so few books about new technology? "You would be surprised how many people who come in here have their own computers," he told Branch Librarian Jean Walton. She made him her computer books adviser, and by February there were 50 computer titles on the shelves and it was time to set up a computer club. Camden Council gave free use of the library where the club has met every Tuesday at 7pm since.

The club concentrates its efforts on newcomers to computing with two beginners' groups and a more advanced programming section. Many of the 30 members who attend each week are still at school.

When we visited, one group was huddled around a Spectrum in the hands of Simon Warren — a radio engineer. They had mastered the essentials of Basic and he was showing them how to debug a program — in this case an error-prone version of Nim. Simon showed how to trace problems in a program but the final error proved elusive and so the group learnt an unexpected lesson — knowing when to give up.

Wil Jackson, who is now the chairman, was explaining the rudiments of computing to newcomers using another Spectrum. In another corner Lucas Fowler the club secretary was demonstrating a ZX-81 input/output board which he had made for an O-level electronics project.

Robert Martin — a professional programs analyst — was explaining structures to the more advanced programmers and advocating flowcharts. He also warned against becoming so obsessed with the program that you forget what you want it to do. "If you proceed from the output you cannot go wrong. If you find a bit of the program interesting and start there you can lose sight of the overall objective — and end up with spaghetti programming."

The club is increasing its links with other groups. While we were there a missionary from Worcester Park preached the benefits of joining the Association of London Computer Clubs.

Camden Council is hoping the Queen's Crescent project will be a success so it can be spread to other libraries in the area. Wil Jackson hopes the effect will be "like ripples on a pond. From Kentish Town to Primrose Hill — and from there you never know where we will get to."

You can find out more about Queen's Crescent Computer Club by calling in at the library or ringing Jean Walton on 01-485 4551. ■

Local society news

Amateurs in Spennymoor

SPENNYMOOR AMATEUR Computer Club in Country Durham meets every Thursday evening at the Spennymoor Recreation Centre. Members own a wide range of home computers, and new members plus their micros are always welcome. More details from Anthony Vincent on 0388-817304.

Stevenage Sinclairs

A COMPUTER CLUB for owners of Sinclair machines has been formed in Stevenage. It meets on the first Wednesday of each month at the Stevenage Library. Telephone John Pearce on 0438-50587 or Bill Googe on 0438-54758 for details.

South Trafford computes

SOUTH TRAFFORD Microcomputer club meets once every two weeks and puts out a monthly newsletter which contains courses in Basic and machine code. The club is open to all serious users with an interest in learning or exchanging ideas. For further details write to Ian White at 16 Leicester Avenue, Timperley, Altrincham, WA15 6AR or phone him on 061-969 2080.

Yate and Sodbury

YATE AND SODBURY Computer Club formed only recently but 80 people attended its second meeting. The club meets on the third Monday of the month in the canteen at Newmans, Station Road, Yate. You can telephone the secretary, Kay Crowe, on 0454-517461.

Brentwood buffs

MEETINGS of the Brentwood Microcomputer Club are held every two months on the third Monday of the month at the Methodist Hall, Warley Hill. The next meeting is on May 16, starting at 7.15pm. The club regularly organises talks and demonstrations. Future meetings will include a visit from a Commodore representative and a talk on network programming. Contact Allan Holland on 0277-221620 for further information.

Starting out in home computing? First Bytes is for you. Just write to *Your Computer* with any hardware or software problems, no matter how small or simple.

QUESTIONS

What are the arrows?

'Tell me more about the cursor control keys. How are they used to control movement?'

LURKING SOMEWHERE on every computer keyboard are the four cursor control or arrow keys which are of particular importance in editing programs, and other text, and in controlling on-screen movement in games.

When you are entering program lines you will find that the left arrow — backspace — often acts as a delete key and will erase the last character which you typed. If your particular implementation of Basic has only a line editor then only the left and right arrows are of use to move back and forth along a single line, but if you are fortunate enough to have a full-screen editor then the up and down arrows will also move you from line to line.

Often the cursor symbols are not displayable on the screen and must be dealt with as their ASCII character codes which are as follows:

	shift not pressed	shift pressed
left arrow	8	21
right arrow	9	93
up arrow	94	95
down arrow	10	91

Organising movement around the screen must take into account how the screen is mapped. The following routine sorts out the four movements in both upper and lower case for a screen addressed as X,Y coordinates.

```
10 X=0, Y=0
20 A$=INKEY$:IF A$="" THEN 20 ELSE
   A=ASC(A$)
30 IF A=8 OR A=21 THEN X=X-1
40 IF A=9 OR A=93 THEN X=X+1
50 IF A=94 OR A=95 THEN Y=Y-1
60 IF A=10 OR A=91 THEN Y=Y+1
90 GOTO 20
```

If you want to ensure that movement does not exceed particular boundaries add:

```
70 IF X<XM THEN X=XM ELSE IF X>XS
   THEN X=XS
80 IF Y<YM THEN Y=YM ELSE IF Y>YS
   THEN Y=YS
```

where XM = minimum value and XS the maximum value of X, and YM = minimum value and YS the maximum value of Y.

Where the screen is mapped sequentially — starting from the top left and returning to the left at the start of each new line — the appropriate lines for modifying the print position (P) are:

```
30 ......... P=P-1
40 ......... P=P+1
50 ......... P=P-LL
60 ......... P=P+LL
```

where LL is the number of characters a line.

I could do that...

Most microcomputers only store integers to eight or nine-figure accuracy. We will award £15 to the shortest program which multiplies two 12-digit numbers and gives the answer to 24-digit accuracy. Entries must be in by the last day in April. Contestants had no trouble in answering March's programming challenge. The winning program was sent in by D Waring, Staddle Stones, Stock Green, Redditch. His solution is simplicity itself:

```
10 INPUT A$
20 LET A$=" "+A$+" "
30 FOR N=0-20
40 FOR M=0-31
50 PRINT AT N, M; A$
60 NEXT M : NEXT N
70 FOR N=20-0 STEP-1
80 FOR M=31-0 STEP-1
90 PRINT AT N, M; A$
100 NEXT M: NEXT N
```

BEATING STOP

DEBUGGING A PROGRAM can be both frustrating and enjoyable. Some people seem to have a gift for homing in at once on the source of a problem. Obviously the more experience you have the more likely you are to develop an intuition for the sort of bugs that cause particular types of error.

But most of us have to adopt a rather more systematic approach and there are several straightforward techniques that can be usefully adopted.

Beginners are often unaware that although a program has crashed, its variables still hold numbers and characters. To find out the value

CHARACTERS PRINTING

ONE OF THE FIRST Basic commands everyone learns is Print which puts characters onto the screen. In its simplest form:

```
10 PRINT "HELLO"
```

The message Hello will apear at the left side of the screen and the print position will then move to the next line below, so that if 20 Print "First Bytes" is added the screen display will be:

```
HELLO
FIRST BYTERS
```

Punctuation is very important in controlling print position as can be seen by placing a comma at the end of line 10, which changes the display to:

```
HELLO                    FIRST BYTERS
```

as a comma only moves the next print position some way to the right and not onto the next line.

If the comma is now replaced by a semi-colon the new print position is directly behind the old one giving HELLOFIRST BYTERS which is not very helpful. To stop the two strings running together place a space at the end of the first one to give

```
"HELLO ".
```

Note that spaces are often automatically left either side of numeric variables to keep things tidy without effort.

When you want to put material in columns a Tab — for tabulator — command is useful. This moves the print position to a particular column of the display on the current line and is most useful for tables. Note the careful punctuation which stops your carefully-chosen print position jumping straight to the next line.

```
10 PRINT "DATE"
20 INPUT DA$
30 PRINT TAB(6):DA$
40 PRINT TAB(15);"CREDIT"
50 INPUT CR$
60 PRINT TAB(24);CR$
```

Even more exact control of print position is available through Print @ — or Print At — commands which specify not only the column but also the line of the display, allowing you to jump easily to any point on the screen.

Their exact operation depends on the dialect of Basic and the way the screen display is mapped. Screen mapping is usually one of two types. In the first the print positions are numbered consecutively from the top left hand corner, jumping back to the left hand side of the screen at the start of each new line.

In the second, print positions are defined on an X,Y grid. Thus

```
PRINT AT 10,10; "HERE"
```

on a ZX-81 and

```
PRINT @ 330, "HERE"
```

THE BUGS AND TRACE

of the variables simply type as a direct command

PRINT A,B,C

or whatever variables you want to look at. You can then work out what values they should have at that stage in the program, and set about finding the point at which they have been corrupted.

Programs that run but do not do what you want them to are even more worrying. The problem may occur because the program is not following the path you intend it to. It may be branching to the wrong subroutine or perhaps may not be returning to the right place.

PRETTILY

on a Dragon both Print 10 lines down and 10 columns across.

For really fancy printing the Print Using facility, which allows you to specify the print format, is invaluable. The structure of this is Print Using format — image of print structure required; output list — what you want to print — and the most common use of this option is in printing columns of cash in a form where only two decimal places are displayed and all decimal points are aligned.

```
10 INPUT C$
20 PRINT USING " # # # .# # ";C$
30 GOTO 10
```

If the following values are input, 123.456: 987.54: 6.4; 4.3211 this is the display:

```
123.46
987.54
  6.40
  4.32
```

Whatever the cause, the first step here is to track down the point at which things are going wrong. A good procedure is to insert Stop commands at different stages of the program and check whether the program runs correctly up to those points. In this way you can eliminate the sections that appear to be working properly and narrow down the trouble spot to a single routine.

One of the most useful debugging aids is a Trace facility. This is built into BBC Basic but some toolkit packages, such as Commodore's Programmers Aid, supply it for other machines.

Trace gives a printout of the line number of each program line before it is executed. A proper Trace facility should also allow you to control the speed at which the program is executed and should print the line numbers in a window in one part of the screen. If these features are not present — as they are not on the BBC Trace — then the line numbers come too fast to follow and overwrite the rest of the display.

If you do not have a Trace facility you can write a simple version yourself: insert a print statement in the routine you want to check telling the computer to print the variables or line number at the top of the screen.

These techniques will not help you if the screen goes haywire or blank and the computer does not respond when you press the escape or break keys.

Almost certainly, in this case, the program has either Poked the wrong location or contains a machine code routine which it cannot break out of program. The only solution is to turn the computer off and start again, right from the very beginning.

Decisions, decisions: branching programs

MOST COMPUTER PROGRAMS involve decisions and have branches in their structure. Although it may appear that the computer has a mind of its own you must always remember that it is only carrying out your instructions to the letter. The simplest type of branch involves testing a variable against another variable — or perhaps an absolute value — and taking some particular action in consequence.

The general form is If condition is true Then take action. for example:

- 10 IF A=B THEN GOTO 100
- 10 IF A=B THEN B=B+1
- 10 IF A=10 THEN STOP

The full form of this type of conditional branch is If condition is true, Then take action 1, Else take action 2, although the latter part is often omitted as, if the first part is untrue, the program will fall through to the next line anyway. Let us consider a situation often found at the start of a program:

```
10 PRINT "DO YOU WANT
   INSTRUCTIONS? (Y/N)"
20 INPUT Q$
30 IF Q$="Y" THEN 1000
40 .......rest of program
1000 .....instructions
```

As you presumably want to return to the main part of the program after reading the instructions Then Gosub 1000 may be better than Then 1000. The test as it stands is OK as long as some clown does not reply with Yes instead of just Y, but if we change 30 to:

```
30 IF Q$="Y" THEN 1000 ELSE IF
   Q$<>"N" THEN 20
```

then only Y and N are acceptable, any other key producing a request for another input.

If you have a complex decision point in a program, such as selection from a menu, then you can use several If-Then tests but things can soon start to look very messy and complicated:

```
100 IF A=1 THEN 1000 ELSE IF A=2 THEN
    2000 ELSE IF A=3 THEN 3000 ELSE IF
    A=4 THEN 4000 ELSE IF A=5 THEN
    5000 ELSE PRINT "TOO BIG"
```

In such situations On Goto or On Gosub can usefully be used instead. The form of this is On expression Goto line number list, where the line number which control passes to is determined by the value of the expression.

If numbers are used in the menu then these can be evaluated directly:

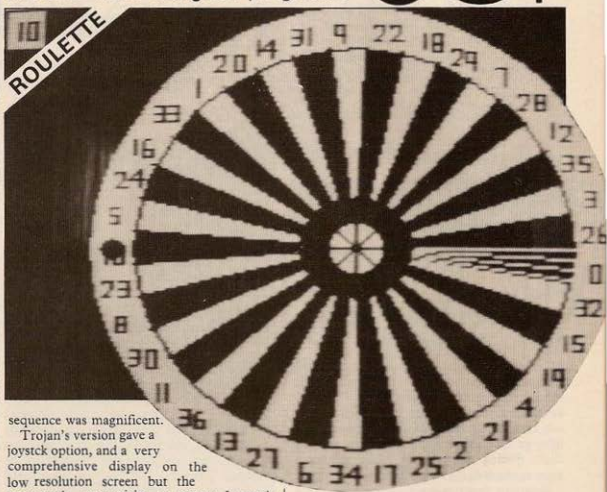
```
100 ON A GOTO 1000,2000,3000,4000,5000
    ELSE PRINT "TOO BIG"
```

To use the letters A to E instead of numbers 1 to 5 you can input A$, determine the ASCII value of this, and then subtract 64 and continue with line 100:

```
80 INPUT A$
90 A=ASC(A$)-64
```

DRAGON SOFT

Once upon a time the Dragon was a fine machine with no software — but now the Brains have picked the best from 100 good programs.



NO HOME COMPUTER will succeed without quality software and plenty of it. The Dragon 32 has been both praised and criticised for shying away from state-of-the-art technology in favour of the tried and tested. In spite of the unfashionable 6809 CPU quantity of Dragon software is not a problem, but how does the quality stand up?

Presentation varies widely from cheap cassettes with hand-written labels to custom-made book-type cases with program notes or separate detailed instruction manuals. Most of the programs were easy to load.

Since the Dragon and the Tandy Colour Computer use pretty much the same version of Microsoft Colour Basic, interconversion of programs was an obvious idea, although there are significant differences between the two machines.

As the cassette-operating systems differ, most Tandy tapes will not load on the Dragon, and only some Tandy cartridges operate correctly, as certain ROM routines are not identical. Only one software house — Microdeal — seems to have followed this route, via licensing deals, for some of the best Colour Computer machine-code software from the U.S.A. We found some of the original author credit lines intriguing as we thought Tom Mix was a pre-war western hero — although as the author of Donkey King and Katerpillar he is certainly no cowboy.

Assessing programs is always difficult as we all appreciate different things. An arcade-game freak looks for close similarity to the original but many people want originality rather than a re-hash of tired old ideas.

Most adventures were traditional text-only types which scarcely exploited the Dragon's capabilities, but they were quite cheap. Taipan is a trading game set in the China Sea, where you travel from port to port buying and buccaneering on the briny. Other adventure games take place in mazes where you roam around collecting valuable objects and weapons, and facing many perils. Scenarios range from seeking treasure in Egypt, questing for the Holy Grail, rescuing stranded potholers in the Mendips, and finding the Orb — whatever that is — we have not found it yet. Pharaoh's Curse from Apex Trading did not seem too powerful and we thought rescue from Death's Head Hole — by Words and Pictures — the most original and interesting.

3-D Maze by Impact Software is graphics only and rather simple. It involves collecting treasure and finding your way out. On the other hand Phantom Slayer, written in machine code, is very fast. It is difficult to zap those hooded phantoms before they get you. If the first shot does not kill it, then run.

Starship troopers

Dragon Trek from Salamander, and Dragon Trek from S W Winter both featured mixed text and graphics on the high-resolution screen and were in real time. This means you cannot wait for ever to make your move. The Salamander version had the largest visual position display, an excellent damage control centre, nice messages from the crew and allowed you to steer photon torpedoes with a joystick, but we must say that the Winter version was also excellent value for money and the picture of the Enterprise in the title sequence was magnificent.

Trojan's version gave a joystck option, and a very comprehensive display on the low resolution screen but the commands were tricky to master. Impact's Star Trek was cheap, hence there are some limitations, but it is worth considering if your Pockets are feeling the strain.

Star Trek III finds it somewhat hard to compete at its price and the Barnsoft version, only using high-resolution in the introductory sequence — which seemed interminable — had very slow response to commands, and fighting Klingons seemed a pretty random process.

The most impressive adventure tested was S W Winter's The Ring of Darkness, which really flexes the Dragon's muscles. A series of sub-programs, each of which is loaded separately, under program control and each constituting a good game in its own right make up the fabric of this game. Having decided what sort of character you want to be, and what particular skills you need, you find yourself on a complex high-resolution map and set out on your search for four rings.

Do you visit a town or buy provisions, weapons or spells and perhaps do a little job on the side for the king, or do you explore deep dark 3-D dungeons infested with giant bats, rats and skeletons? How can you reach those islands, and can you cope with the constant attacks of various foes? A very complex adventure which could take a lifetime to solve. This soon displaced breakfast television in our house.

Many compendia of games, of varying quality, are on offer but all reviewed here offer a reasonable range of programs at a fair price and can be recommended, particularly to new users. The best buy must now be the recent Games Tape 1 from a new source — Active

SURVEY

WARE

Software — which has taken some established ideas and implemented them beautifully using all of the Dragon's facilities cleverly. There are eight games, several of them as good as those offered elsewhere as individual cassettes.

In Interplanetary Trader you voyage the galaxy for blatant personal gain, dealing with the bank, and avoiding various perils, whilst keeping you ship in one piece.

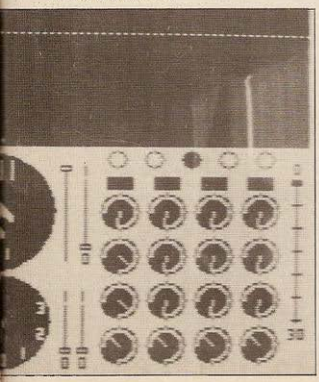
Execution is a colourful re-interpretaton of Hangman with a first-class moving high-resolution display of a firing squad in place of the scaffold, and a tuneful rendering of the Mexican Hat Dance. Wumpus Mansion is a game with two mazes, you travel the first seeking treasure and avoiding Wumpi — revolting things — and race through the second if you have the misfortune to trigger a time-bomb.

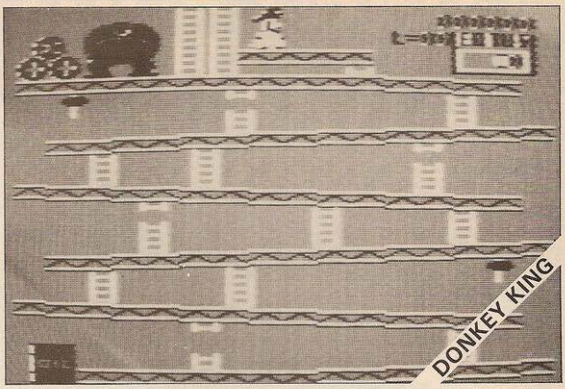
Wipeout is a variant of the old snake idea. You slither around the screen collecting items, but not crossing or going back on your track.

Hi-Lo is rather like "Play Your Cards Right" but has the advantage of doing without Bruce Forsyth. Snail's Pace makes a change from horse-racing, and Atom Hunt requires some brainwork, but Air Assault is just good old-fashioned aggression as you bomb the city to make enough room to land your helicopter.

A series of innovative family-orientated multi-player games come from Shards Software. Dragon Fun and Games is excellent for children's parties.

The first Gem Pack, from Gem Software, offers four games of skill, the second Gem Pack offers two skill games plus two strategy games, and the third complex versions of Reversi and Pontoon.





J C Morrison's tapes are excellent for your arcade games fans as they each contain three diverse and very fast machine-code programs. DGT2 contains Snakes, Lander and Invaders and DGT4 feature Pterodactyl, Torpedo Run and Hornet.

Garland Software has released physics and biology programs, which are particularly useful to schools. All programs use both text and graphics, repeatedly question the user on his knowledge, and allow any section to be repeated.

Useful animation is included in Action of the Heart — showing blood flow and electrical activity — and Principles of the DC Motor — especially the perspective view of a moving motor at the end — and the Ohm's Law program features a useful simulation of an experiment which requires you to take readings from the screen, checks your accuracy and plots a graph of your results.

The educational value of these programs is high and our only real criticism is the jump-back from the high-resolution pictures to the text screen when user input is required, which makes it more difficult to consider your answer.

Skill may mean different things but arcade games are the highest test of reaction and co-ordination. Microdeal has an extensive range of first-class machine-code look-alikes of all the favourites. Planet Invasion is very hard and if you are fed up with zapping and being zapped then try Donkey King: rescue the fair maiden from that maniac gorilla with the endless supply of barrels by jumping and hammering at the right moment.

The popularity of golf programs was a surprise — surely people play golf to get out in the fresh air, or is the 19th hole merely a substitute for the one-armed bandits?

The best — for the true golfer — is Salamander's. It closely approximates the actual game procedure, includes wind, sloping greens and an obvious thud when your trajectory ends in a bunker. The use of a movable aiming point rather than compass directions is particularly good. Apex offer a much cheaper and quite reasonable high-resolution alternative. For the non-golfer who just wants another game, or for youngsters, the low-resolution Handicap Golf from Computer Rentals is perhaps your cup of tee.

Grand Prix, from Salamander, allows one or two players to try their driving skill with the joystick on versions of all the major motor-racing circuits of the world, or if that is too easy what about flying a Jumbo Jet? 747 Simulator — from DACC — lets you try cold-start, warm-start and landing approach and has a very complex and realistic flight-deck display. Keeping control of the 747 is hard even without the occasional systems failures which were generated — I wonder what Boeing would have to say about this — and flying this program is a real simulation, rather than just another game.

Dragon slaying

Tenpin, by G Newman, was a reasonable simulation of bowling, including an accurate update of your score card on screen, but the ball was rather small and difficult to see. If you are stuck on the space theme UFO — Computer Rentals — allows you to pit your wits against 10 different types of alien ship and Luna Lander — St George Software — was quite difficult.

We nominated St George and the Dragon from Computer Rentals as the most original and amusing game. This is an animated graphics program in which you kill — or avoid — the fire-breathing dragon, cross a river, and smite a magic rock asunder with your sword to release the princess. Two versions were included, for joystick and cursor keys, the former being extremely difficult and the latter merely impossible. Killing the dragon is a cinch compared with balancing on the bridge and swimming with armour on.

If brainpower is your forte then consider the games of strategy. St George Software's Checkers was simple — and cheap — but still beat us, so what hope did we have against Salamander's three-dimensional Vulcan Noughts and Crosses. No wonder the latter has a zero player option where the machine tries to out-think itself as you sit back and watch in amazment. In MC Lothlorien's

(continued on next page)

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Samurai Warrior you have to weigh up which of your colleagues to fight to the death, but the graphics are rather slow and predictable. Tyrant of Athens, also by Lothlorien, is a better idea, representing the Hellenic Wars.

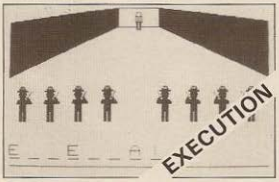
For those planning World War III there is the more complex Strategic Command from Romik where you build up and deploy your land and sea forces against the enemy. Keeping track of the entire disposition of your forces, and selecting targets, becomes difficult and we deplore the absence of an arms limitation conference option.

If money, rather than military might, takes your fancy then invite your friends in for a flutter at Charm Computer Software's Roulette, where the wheel stands still and the ball goes round, but the bank still wins. An alternative multi-player money game in Space Monopoly from Microdeal. You must select your outposts and make your investments with due regard to the possibilities of expansion and takeovers.

Wizard Wars from Salamander is a clever technological development of the old "Paper-stone-scissors" schoolyard game, in which teams of wizards select diabolical and protective spells as they battle to destroy each other. There is a whole book of complex spells with differing potencies, energy requirements, and possibilities of backfiring, to be learnt if you are to triumph.

An increasing range of Dragon utilities is appearing. Artist's Designer from S W Winter allows you to construct high-resolution drawings with ease and also to write text on the high-resolution screen. Character Generator — Gem Software — allows you to define your own high-resolution character set on a nine by seven matrix, and Save this for use elsewhere. It makes character definition easy and detailed written instructions are supplied, but in use text appears rather slowly as PSet rather than Draw is used. An interesting 3-D demonstration of the manipulation of an image in three-dimensions is included.

Micro Music Map, from Cotswold Computers, is a chart giving conversions from



sheet music to Dragon Play format, particularly useful to non-musicians who wants to include tunes in the program.

Compusense's Demon — cartridge — and PSS's Dragbug — cassette — both provide monitors which allow you to inspect and modify memory and register contents so that you can create your own machine-code programs. As the main part of Demon resides in the cartridge area, little user memory is taken up and, whilst Dragbug includes a disassembler and a printer driver, Demon allows you to inspect memory in ASCII format, and include various monitor subroutines in your own programs. Demon also comes with clearer instructions, and is compatible with other software to be released by Compusense — including an editor-assembler. The disassembler from Rampage gives output of selected memory contents to screen and printer in standard 6809 mnemonics.

The two text-processors Telewriter from Microdeal, and Textstar from PSS, could both be used as word processors and indirectly, to produce and edit Basic programs with the benefit of a full-feature editor. In this application the value of the Dragon's "real" keyboard becomes particularly apparent. Both programs provide a useful range of text-handling facilities including full-screen editing, moves, search and replace, formatting, cassette saving and merging. Textstar also includes alpabetical and numerical sort, line and column display, and right justification, and is relatively inexpensive, but it uses the normal limited Dragon text screen and character set. As a real word processor Telewriter — U.S. transplant via Microdeal — is much more practical as it provides true upper and lower case characters on a black-on-white, 51 columns by 23 lines screen display. This accepts a wide range of printer control functions, block copy and delete, selective search and replace, word and line count, page-numbering, Verify, auto-retry during file search, partial Save and Print, queueing of

(continued on page 45)

Type	*Supplier*	*Players*	*Price*	*Originality*	*Accuracy*
Adventures					
Text only					
Orb	11	1	£5.00	**	—
Pharaoh's Curse	2	1	£4.95	**	—
Rescue from Death's Head Hole	25	1	£4.45	***	***
Taipan	12	1	£5.00	***	**
The Quest	11	1	£5.00	**	—
Graphics only					
Phantom Slayer	14	1	£8.00	****	—
3D Maze	11	1	£5.00	**	—
Text and Graphics					
Ring of Darkness	24	1	£10.00	*****	—
Star-Trek					
Dragon Trek	24	1	£6.99	—	****
Dragon Trek	20	1 J	£9.95	—	*****
Space Trek	23	1 O	£7.50	—	****
Star Trek	3	1	£6.50	—	**
Star Trek	11	1	£5.00	—	***
Star Trek III	22	1	£8.00	—	***
Compendia					
Dragon Family Programs	21	V	£6.00	****	—
Dragon Fun and Games	21	V	£6.00	****	—
Games Compendium	20	V	£7.95	***	—
Games Pack 1	10	V	£7.95	**	—
Games Pack 2	10	V	£7.95	**	—
Games Pack 3	10	V	£7.95	—	****
Games Tape 1	1	V	£5.75	*****	—
Dragon Games 2	15	1	£6.95	—	****
Dragon Games 4	15	1	£6.95	—	****
Educational					
Action of the heart	9	—	£11.00	***	****
Digestive system	9	—	£9.90	***	****
Ohm's Law	9	—	£9.00	*****	****
Principles of the DC motor	9	—		*****	****
Skill					
Defence	14	1 H	£8.00	—	****
Donkey King	14	1-2 J	£8.00	—	****
Dragon Space Mission	10	1	£7.95	—	***
Dragon Monster Mine	10	1	£7.95	—	***
Katerpillar	14	1 J	£8.00	—	****
Invaders Revenge	14	1-2 O	£8.00	—	****
Planet Invasion	14	1 J	£8.00	—	****
Scarfman	14	1 O	£8.00	—	****
Dragon Gold	10	1-2	£7.95	*	**
Golf	20	1-2	£7.95	****	*****
Golf	2	1-2	£4.95	**	***
Handicap Golf	6	1-2	£6.95	**	***
Grand Prix	20	1-2 J	£7.95	—	****
Luna Lander	22	1	£4.00	—	***
St George and the Dragon	6	1 O	£6.95	*****	—
Tenpin	16	1	£7.00	—	****
UFO	6	1 J	£6.95	—	***
747 Simulator	8	1 2J	£9.95	—	****
Strategy					
Checkers	22	1	£3.50	*	****
Roulette	4	1-9	£4.95	***	****
Samurai Warrior	13	1	£6.95	**	**
Space Monopoly	14	2-4	£8.00	****	***
Strategic Command	19	2 2J	£9.99	****	***
Tyrant of Athens	13	1	£6.95	**	***
Vulcan Noughts and Crosses	20	0-2	£7.95	***	—
Wizard War	20	2-9 2J	£7.95		
Utilities					
Artist's Designer	24	O	£6.99	**	—
Character Generator	10		£9.95	**	—
Demon	5		£18.40	****	—
Disassembler	18		£5.00	*	—
Dragbug	17		£9.95	**	—
Micro Music Map	7		£3.50	***	—
Telewriter	14		£50.00	*****	—
Textstar	17		£11.95	***	—
Threedee	22		£5.00	***	—

Table of games reviewed. J means joysticks required; O means joysticks are optional, and V means the number of players varies.

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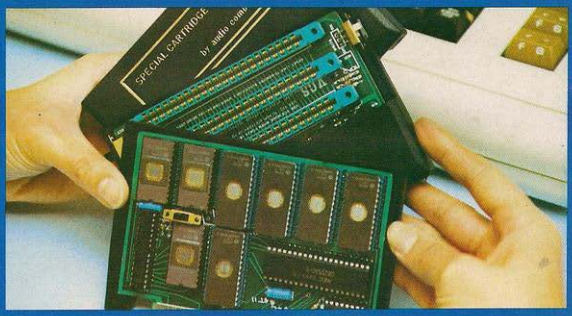

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(continued from page 42)
cassette files for Print, and repeat headers. Cassette files are saved as very compact machine-code dumps rather than the extremely slow ASCII format used by Textstar.

Four different versions, optimised for different printers, are included, together with a conversion program for work on Basic programs. First-class documentation comprising a step by step tutorial and a reference manual are included and Telewriter represents excellent value as a word processor for the serious Dragon user which, at £50, looks very good in comparison with Wordcraft for the Vic-20.

CONCLUSIONS

- An excellent range of games software for the Dragon has emerged, at prices which compare well with material for competitive machines, and substantial offerings on the serious side are now appearing, all of which augurs well for the future of Dragon Data.
- Various rumours are circulating about hardware modifications, ROM bugs and RAM reconfiguration which can cause problems on some machine-code programs, so if you have a program that runs into difficulties consult your supplier.
- One point to watch when using programs one after the other is the last state of the reserved graphics pages. These can easily cause out-of-memory errors on the next program if you do not turn off between programs.
- A final word to small suppliers — please remember multiple copies are really no substitute for a decent recording. There is nothing so frustrating as a program that will not load. ■

Software suppliers. Numbers correspond with those given in the table of games reviewed.

1 Active Software, 32 Moors Lane, Northfield, Birmingham B31 1DH.
2 Apex Trading, 115 Crescent Drive South, Brighton BN2 6SB.
3 Barnsoft, 48 Waverley Road, Portsmouth, Hampshire.
4 Charm Computer Software, 243 Shirley Road, Acocks Green, Birmingham B27.
5 Compusense, PO Box 169, London N13 4HT.
6 Computer Rentals, 140 Whitechapel Road, London E1.
7 Cotswold Computers, Park Hill, Hook Norton, Oxfordshire.
8 DACC, 23 Waverley Road, Hinderley, Greater Manchester WN2 3BM.
9 Garland Computing, 35 Dean Hill, Plymouth PL9 9AF.
10 Gem Software, 22 Prestwick Drive, Bishop's Stortford, Hertfordshire CM23 5ES.
11 Impact Software, 70 Redford Avenue, Edinburgh EH13 0BW.
12 Jaysoft, 6 Wentworth Drive, Bishop's Stortford, Hertfordshire.
13 M C Lothlorien, 4 Granby Road, Cheadle Hume, Cheshire SK8 6LS.
14 Microdeal, Deal House, Luxylan, Bodmin, Cornwall PL30 5EF.
15 J Morrison Micros, 2 Glensdale Street, Leeds LS9 9JJ.
16 G Newman, 12 Malden Park, New Malden, Surrey.
17 PSS, 452 Stoney Stanton Road, Coventry CV6 5DG.
18 Rampage, 32 Birchwood Drive, Wilmington, Dartford, Kent DA2 7NE.
19 Romik Software, 24 Church Street, Slough SL1 1PT.
20 Salamander Software, 27 Ditchling Rise, Brighton, East Sussex BN1 4QI.
21 Shards Software, 10 Park Vale Court, Vine Way, Brentwood, Essex, CM14 4UR.
22 St George Software, 6 Storrsdale Road, Liverpool L18 7JZ.
23 Trojan Products, 166 Derlwyn, Dunvant, Swansea SA2 7PF.
24 S W Winter & Co, 101 Westminster Bridge Road, London SE1.
25 Words and Pictures, 7 Hawthorn Crescent, Burton-on-Trent DE15 9QP.

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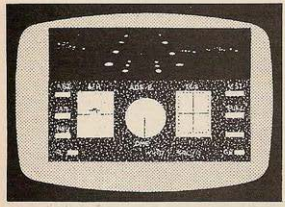

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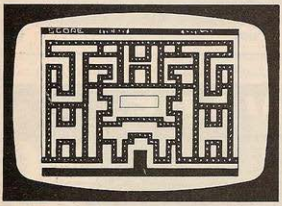

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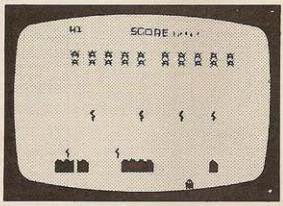

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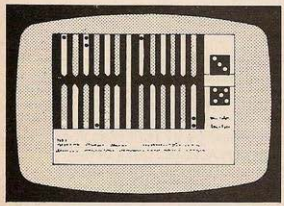

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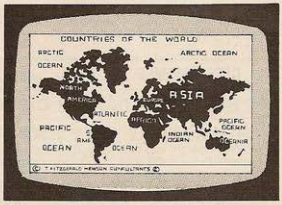

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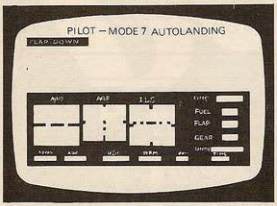

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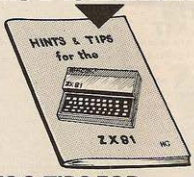

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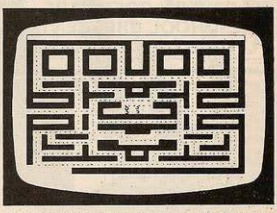

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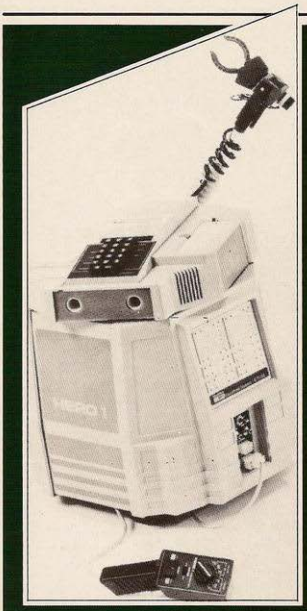


Watch out there's a robot about. The BBC Buggy is not alone. From £30 to £2,500 the robots are ready to move into your home.

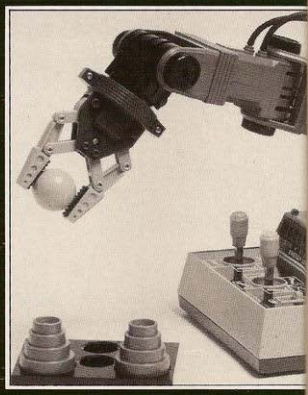
The Buggy's only competition comes from the Japanese toy industry and infant American domestic robot industry.

Tomy's Robo 1 was the star of the British Toy Fair at Earl's Court. A toy version of an industrial robot arm, it is battery run and controlled by two joysticks at the base. The arm itself can be swung up and down through 180 degrees and turn 360 degrees horizontally. Further dexterity is provided by the wrist which can swivel in almost any direction. By controlling the Robo 1's claw hand the operator can grip, pick up, rotate, move and release objects with remarkable precision. This is a well constructed and absorbing toy which sells for just £30.

Like the Buggy the Hero-1 is a programmable three-wheeled vehicle driven by two stepper motors and sold in kit form. Looking like a cross between Dr Who's K9 and Star Wars R2D2 it more closely conforms to the popular idea of a robot. Unlike the Buggy the Hero-1 is self-contained with an on-board microprocessor and its own battery power supply. It uses a 6808 processor with 4K RAM and 8K ROM. Instructions are entered via a hexadecimal keypad.

The Hero-1's range of sensors is far more extensive than the Buggy's. As well as a light detector it has detectors which can sense sound, motion and distance. It uses a sonar system to work out the distance of objects within a range of eight feet. There is also a built-in clock and options for a speech synthesiser and gripper arm.

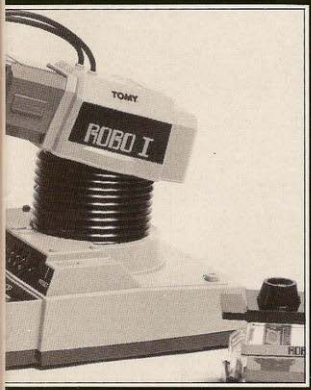
This is obviously a more sophisticated package than the Buggy and a much more expensive one. In the U.S.A. the Hero-1 robot kit sells for $1,000 without the arm and speech synthesiser. Heath Electronics U.K. will be launching a fully-assembled version including the arm and synthesiser for £2,455



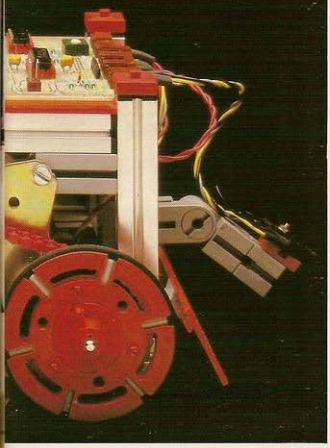
MARCH OF THE R

REVIEW

which will be available later this month. But in some ways the Buggy offers the user greater scope for exploring robotics. It is easier to program and the BBC Microcomputer allows for more versatile software applications than the Hero-1's on-board computer.



OBOTS



Designed for the home. Built by screwdriver. Tested by Simon Beesley. Buggy — the world's first affordable robot.

BBC BUGGY

IF YOU HAVE grown tired of all those video games and have exhausted your machine's programming potential you can now revive your interest in computing with the BBC Buggy. This is a three-wheeled vehicle which can be controlled by a BBC Micro and programmed to move in any direction, detect collisions, detect light, read a bar-code, and operate a pen-up/pen-down mechanism. In short it is a robot — and at around £120 it is the first to come within the range of the home computer user rather than the electronics hobbyist.

The Buggy is the fruit of a collaboration between the BBC Computer Literacy Project and the Microelectronics Education Programme. After discussing ideas for the BBC's *Making the Most of the Micro* series with producer David Allen, Mike Bostock, Technology Manager for the MEP, built a prototype Buggy using Lego bricks. "Everyone wants to build a robot", he says, "and at the age of 33 I finally built one".

When the Buggy goes on sale this month it will come as a construction kit containing a chassis, two stepper motors, three types of sensor, control cables and electronic circuit boards. To go with it there is a tape with 13 programs, documentation, a Buggy handbook and assembly instructions.

Fortunately the review robot arrived ready-built so we did not need to test the claims of Buggy-maker Economatics that the kit can be easily assembled in about two and a half hours using only a screwdriver.

The main body of the vehicle is a five-inch cube driven by two stepper motors which turn the front wheels. At the back there is a ball-bearing which acts as a balance wheel for the vehicle.

Using stepper motors greatly simplifies steering the Buggy since the motor can only be advanced by a fixed step at a time. This allows precise control of the vehicle's movement. Each motor has independent control over its respective wheel and the gearing is such that a single pulse to the motors rotates the Buggy by one degree.

It is comparatively easy to send the Buggy a specified distance forwards or backwards, or rotate it through any given angle. The two motors drive the vehicle at a rather stately pace with sufficient power for it to authoritatively brush aside obstacles such as books, in bulldozer fashion.

Top speed was measured at one and half miles per hour — hardly enough to trouble the man with the red flag. At the front is a split bumper with left and right microswitch collision detectors and above it a light detector — LDR. There is also a bar-code reader — BCR — mounted on a hinged arm which extends between the bumper and the LDR.

This consists of an infra-red light-emitting diode — LED — and photo-diode which respectively send out and receive infra-red light. The BCR detects a black line by measuring the amount of light it reflects. My only criticism of the vehicle's design is that the BCR arm is inconveniently positioned. Although it can fold back it tends to prevent the bumpers below from registering a head-on collision.

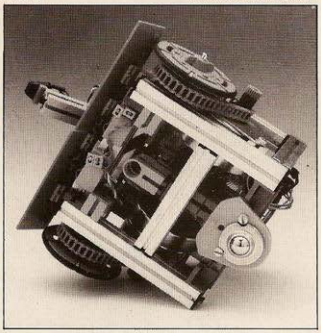
Logo-style turtle

In the Buggy's centre of rotation there is a pen-up, pen-down mechanism which is mounted on the centre axle and controlled by an electro-magnet. This will permit the Buggy to be used as a Logo-style turtle. It is not quite as accurate as a dedicated Logo turtle but is £180 cheaper.

On the BBC Micro the Buggy is controlled through the user and analogue-in ports. Both the LDR and BCR return an anologue input proportional to the intensity of light measured. The collision detectors send a digital on/off signal to the user port.

Each of the user port's eight bits provides a control line. Four of the lines from the user

(continued on page 53)



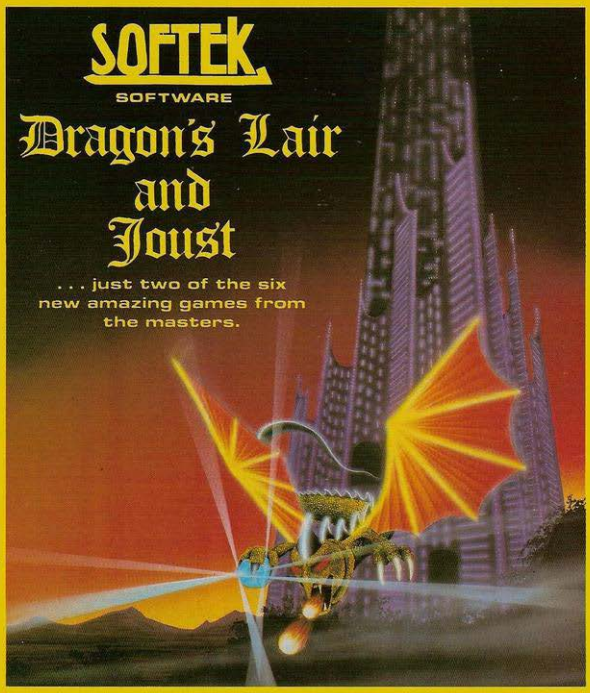
Dragon's Lair

I thought it would be easy . . . explore the Dragon's Lair and find the Crystal of Power with which to destroy him. But I didn't count on the dangers that confronted me. There were others in that mind boggling maze too!

The Ultimate 3D Maze-Adventure, for the 48K ZX Spectrum.

Joust

It's taken America by storm — now it's available for your ZX Spectrum! In this amazing new arcade game you Joust with the Dark Lords in an other-worldly setting. Quite amazing animation as you fly your Ostrich by controlling the flap of its wings! By Andrew 'Orbiter' Glaister



MONSTERS IN HELL

It was like a nightmare. Trapped in Hell, the all consuming flames below me, running from the Vampire monsters through a maze of platforms and ladders. I had Holy Power on my side, though, and could survive if I replenished it frequently. And the only way to kill them was to make them fall through holes I created with my hammer. But then the Mad Monk sent his ghouls after me . . . Any ZX Spectrum. By Mark Lewis

COSMIC SWARM

OK, I accept I'm to blame. I disregarded orders and entered the Altair sector. Eggs, eggs, everywhere — I shoot, two fantastical alien types appear, whose touch is deadly! They join, seemingly by chance, into a mutant which chases me! Probably the most original new space 'shoot-em-up' game to appear. Any ZX Spectrumn. By Andrew Beale

MILLIPEDE

Milli the Millipede seemed indestructible; no matter how much of her body I shot away she kept coming! But then Sid the Spider appeared from nowhere, and Scorpi zoomed across dropping her indestructible fleas on me! A quite astounding version of the arcade favourite. £5.95. By Andrew Blake

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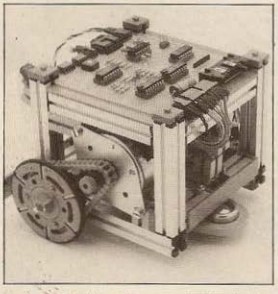
(continued from page 51)
port are used to control the stepper motors; one bit is used to turn on and off the electromagnet for the pen-up, pen-down mechanism, and two further bits are allocated to register the left and right collision switches.

I was pleasantly surprised at how easy it was to write controlling software for the Buggy. Once I found out how to write to and read from the user port it did not take long to write a short program to steer the Buggy from the keyboard, detect collisions and operate the pen.

Although the Buggy only runs on a BBC Micro at present, it should be possible to drive it from any micro with an eight-bit parallel port. Machines without analogue ports would be at a disadvantage and would require additional hardware to give the light sensors an on/off reading. Economatics is contemplating adapting the Buggy for the two machines on the DoI's list of recommended micros for schools — the Spectrum and Research Machines 380Z.

A robot can be described as an artificial intelligence in an artificial body. While the vehicle itself provides the body the BBC Micro or rather the programs it can run supply the intelligence. Along with the electronics and ironmongery almost 100K of software is supplied with the kit. The programs are graded and designed to take the user step by step up the artificial intelligence ladder.

In the process they show how a computer



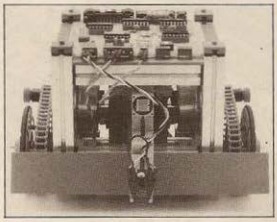
can be used with a robot as a switching device, a memory, a graphics terminal, a programmable device, an information processor and a problem solving unit. Since they demonstrate what the Buggy is capable of they are worth describing in some detail.

Test, the first program, checks that the Buggy is correctly set up and enables the user to test the sensors, displaying their input on the screen. This is followed by Switch, a short program, which lets you drive the Buggy in any direction by pressing the cursor keys. The vehicle is quick to respond and can be readily steered hither and thither.

As an advance on this facility Memory Switch records the key presses and can replay them in their sequence or in reverse order. This demonstrates how precisely the Buggy's movement can be controlled sending the Buggy along quite a complicated route several metres long and then commanding it to return, bringing it back to within a few centimetres of its starting position.

Recorder draws a map on the screen of the Buggy's progress while giving readouts of its position in an instrument panel below the map. Collisions are registered with a convincing crashing sound. Snail likewise plots the Buggy's path but also allows you to give it a coded sequence of instructions first, such as R30 or F50 meaning Turn Right 30 degrees or Go Forward 50 centimetres.

There are two programs which show how the Buggy can read in quite complex information from bar-codes. In Tin Pan Alley it reads musical information from a line of bar-codes, plays the tune and displays an animated score on the screen. Bar-Code Route Planner



instructs the Buggy to follow route instructions given on bar-code cards.

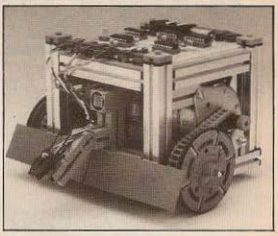
The remaining programs, in which the robot appears to act under its own control, demonstrate some of the principles of artificial intelligence. The Buggy is instructed to perform such tasks as seeking out an object and working out its size, following a black or white line, and measuring an enclosed area. Sunseeker programs the robot to track down a light source.

Once it has located its goal it homes in negotiating any objects in its way. Man versus Buggy requires the user to perform the same task — to drive the Buggy from the keyboard using the same information as is available to the computer which it presents on an instrument panel.

As soon as the vehicle starts to move in a purposeful manner it is difficult not to ascribe intelligence to its behaviour. One of the Buggy's predecessors, Dr Grey Walter's tortoise was a three-wheeled vehicle which could travel around a room avoiding obstacles. It was programmed to look for a power point to plug itself into and recharge its batteries when they ran low. Onlookers tended to feel empathy with it in its quest. The Buggy can provoke a similar response. It is bound to be a success in schools.

The 13 programs in the software kit are written in Basic and the procedures they contain can be incorporated in the user's own programs. There is clearly scope for more advanced artificial intelligence applications.

People who saw the Buggy on the BBC's *Making the Most of the Micro* series will have seen it finding its way around a maze until it reached a light source at the end and then returned to the start. If the robot were fitted with a grab-arm it could for example be programmed to demonstrate the principles of



the computerised warehouse. It would use the BCR to follow a line to a set of pigeon holes, then locate a pigeon hole which had been lit up, remove an item with a grab-arm, read its bar codes and use the information given to docket it elsewhere.

A grab-arm is one of the hardware expansions Economatics is considering. Other possibilities could be in the form of extra sensors such as a proximity detector or a heat detector.

The MEP stresses that the robot should not be seen just as a toy. But the term toy need not be applied dismissively. After all for most owners' home computers have no practical application and could be described as adult toys. Whether or not everyone wants to build a robot, the idea of controlling a robot exerts a fascination for most people. The Buggy's inventor Mike Bostock frankly describes it as "modern day Meccano."

People are not so much interested in the practical role of robots as uncomplaining drudges capable of performing menial tasks, as in their ability to carry out more complex and intricate routines. Linking the Buggy to the BBC Micro gives it considerable potential for such exercises in artificial intelligence.

Once the MEP which developed the Buggy sees it as finding a place in both the home and school. Andrew Hopkins who has written the manual describes it as one solution to the problem of introducing more technology into the curriculum. Whatever its application the Buggy is certainly enjoyable to play with as well being a useful introduction to control technology and artificial intelligence.

CONCLUSIONS

- The Buggy may not be able to do the washing-up or the housework for you but it can provide an excellent introduction to robotics and control technology.
- As an educational device which has its place in many different parts of the curriculum the Buggy should be very popular. It is fun to use and easy to operate. Its low cost also puts it within the reach of home computer users who are interested in robots.
- The Buggy's capabilities are well demonstrated by the 13 programs which accompany it. These do not exhaust its possibilities and there is plenty of scope for a variety of more complicated applications. ■

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TEN YEARS AFTER Texet drove Sinclair out of the pocket calculator market the TX-8000 is ready to take on the ZX-81 and the Spectrum. As with the calculators Texet hopes to win customers by aggressive pricing. But although the £98 TX-8000 is now the cheapest colour micro — by a whisker from the Oric and by £27 from the Spectrum — it has only 4K RAM as opposed to the 16K of its rivals.

The Z-80 based TX-8000 has a specification that, on paper, looks very good compared with the ZX-81. When it is compared with, for example, that of the Oric, then a number of weaknesses become apparent.

Of the three colour computers under £125 — the Spectrum, Oric and TX-8000 — the TX-8000 is the largest. It case is made of a cream plastic, which feels more brittle than the plastic used for its rivals — but it would still require an act of malice to break it. The design of the case is not as polished as that of its rivals, but it does have a gently sloping front which means the keys actually face the user.

The dimensions of the case are 12in. wide by 6in. deep, 2in. high at the rear and 1in. high at the front. The panel containing the keys is dark brown and sunken into the body. There are 45 keys in a rubber keyboard which is very similar to that of the Spectrum. Not only do the keys squash down in the same way they even have that distinctive clammy feel to them. If anything the Texet keyboard feels worse than the Spectrum's.

Individual keys are smaller than on the Spectrum, but there are more of them. Keyboard layout is based on the usual QWERTY typewriter formation, which the TX-8000 mimics better than the Spectrum. This necessitates fewer key depressions, especially in the case of punctuation symbols which can only be achieved by a shifted key on the Spectrum but have their usual typewriter keys on the TX-8000.

Above the first eight number keys there are the corresponding colour names; yellow, blue, red, buff, cyan, magenta, orange and green. This is the same colour set as on the Spectrum but with the addition of buff and orange. Interestingly, there is no black or white, which look in theory to be unobtainable.

When using the keyboard the letter pressed is what appears on the screen, even though certain Basic keywords are printed above and below the keys. The keywords are accessed by the kind of finger gymnastics that put me off the Spectrum when it first appeared. Alongside the keyboard is a power light which tells you when the machine is on, which sometimes is not apparent from looking at the screen.

On the right-hand side of the machine is a rocker-type switch, to turn the power on and off. This is a welcome feature, as anyone using a Spectrum or ZX-81 will know that the continual insertion and removal of the power supply plug eventually works it loose. So a cold reset — that is a reset of the computer which clears the RAM — is a simple operation.

Although the machine is marketed in this country as the Texet TX-8000, elsewhere it is known as the Video Technology VZ-200. This is taking badge engineering to new heights. The Texet is exactly the same as the Video Technology machine except for the VZ-200 badge. Both machines are manufactured in Hong Kong, the factory-door price of the VZ-200 being $66 — less than £45.

The real significance of this similarity is that there are a number of interesting peripherals available for the VZ-200, which will work with the Texet. These include: 16K and 64K Ram extensions, joysticks, printer, light-pen, Modem, disc-drives and bar-code readers. There is also an interface unit which allows you to use any standard text or graphics printer. All these add-ons are manufactured by Video Technology in Hong Kong and will be available in the U.K. from Texet. Projected prices are: printer, £129; 64K Ram expansion, £52; £8 for a single paddle and £60 for a pair of cordless remote control joysticks.

Opening up the inside of the Texet is like digging in the garden of the Cricklewood house of horrors. A number of vaguely familiar objects are recognisable amongst the mess even though all the identifying codes on the chips have been painted out to preserve their anonymity. There is a black and white model of the VZ-200 in Hong Kong and one look inside the case of the Texet shows that it is basically a black and white computer that has been converted for colour. The colour circuitry is antique by the standards of the Oric or the Spectrum, with a large number of presets, pots, coils and resistors.

On the rear of the machine are the usual power and TV output sockets. In addition there is a tape socket, which unlike conventional tape sockets is a stereo jack socket — the kind used on portable hi-fis. This connects to two mono jack plugs, red and black, the red one being the Ear connection and black the Mic.

There is also a monitor output — which will not work with most monitors. Also along the back of the machine, but covered by a couple of aluminium panels are the bus expanders. One is marked Memory Expansion and the other, Peripheral. This may imply that only one peripheral can be connected at a time. The panels are attached to the computer by two tiny screws.

Power for the micro comes from a transformer which would plug straight into the power socket except that it has a two-pin electric shaver-type plug. This needs a special adapter to enable it to be used with domestic U.K. power sockets. Unfortunately the pennies this adds to the price of the micro makes the Texet only a pound cheaper than the Oric.

Because the transformer itself is attached to the plug its weight causes it to work its way out of the socket. While this is not likely to be dangerous, due to the insulation on the pins, it does mean that a programming session can be ruined and all work lost due the the resulting power failure.

When the machine is powered up the message:

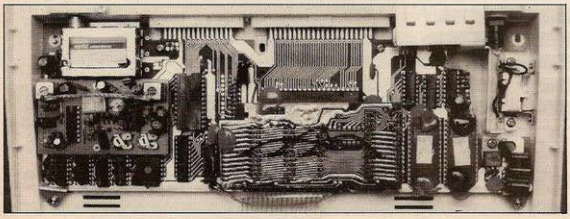
VIDEO TECHNOLOGY
BASIC V1.0

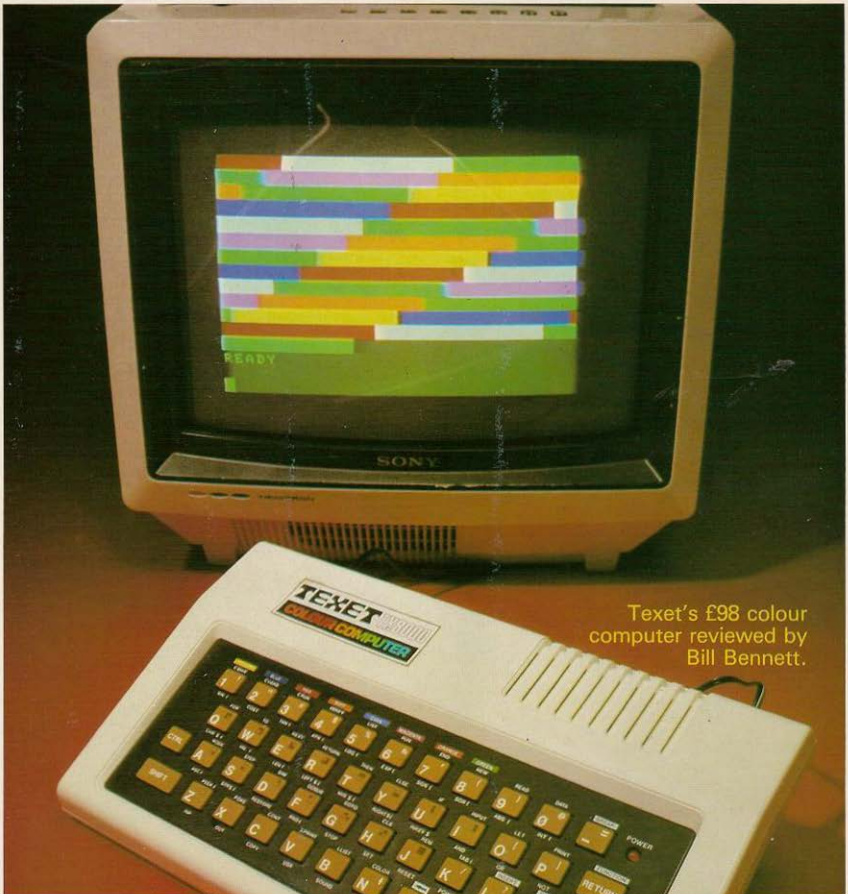
appears. The letters are in light green on a darker green background with the whole surrounded by a black border. The cursor — a square of light green, flashes on and off. If the on/off switch is flicked momentarily to the off position and back again a bizarre effect on screen is caused by the memory-mapped screen area of RAM being filled with garbage.

The TX-8000 has only 4K RAM — and 2K is available for programs, the other 2K is for the screen. The maximum size of a numeric array defined in a Basic DIM statement is 1313 locations and a string array can hold 1751 strings.

Of course should you decide to use arrays that big, there will not be any room left for the program. Anyone who has used the ZX-81 might think 2K is a lot of memory, especially when it does not have to store the display as well. If you were a bit tight for space, you could try storing numbers as strings though.

With internal circuitry that looks like this (below) it is not surprising that colours are displaced by half a character on screen.





Texet's £98 colour computer reviewed by Bill Bennett.

Arrays may be multidimensional, but be warned, arrays of more than one dimension eat heavily into the memory. By the time you get to an array of seven dimensions, (2,2,2,2,2,2,2), you have run out of memory.

A simple line of Basic, such as:

```
10 x=20
```

only takes up four bytes so a reasonable program can be squeezed into the memory. However this compares very unfavourably with the Oric, which is only a fraction more expensive, but has a nominal 16K of RAM.

The organisation of the video memory is interesting, in the normal text mode — which is called from Basic by the command Mode(0), the first 512 bytes of video memory store the ASCII codes of the screen characters.

Any of the machine's character set of 255 characters can be Poked into this memory, and of course it is the area that the Print command uses.

All the usual characters appear in the set, together with their inverses. In addition there is a subset of graphic characters which consist of the character square divided into four smaller squares, filled in all possible combinations. This graphic subset is repeated four times. When the machine is initially turned on this character set appears in four different colours but use of the Color command — which is similar to Ink on the Spectrum — changes this, and the four sets seem to change to arbitary colours.

(continued on page 59)

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(continued from page 57)

Color only affects the graphic symbols. There is no provision for printing words or letters in colour. What is strange is a lack of black or white on the screen. In practice the colour designated as Buff is slightly off-white and for most purposes can be used in its place. Black can be obtained only as the other colour in the graphic symbol character set.

There is a major problem with the colour on the Texet, it seems that each of the colours is attributed to a character space that is displaced half a character to the right of the printed character. That is, the printed characters and their assigned colours do not match up on the screen. This could be a fault in the review machine, but looking at the colour circuitry within it is not surprising.

It is a shame about the colour location problem, because the colours themselves are the brightest on any of the cheaper colour computers. The red is a little darker than it should be, but the blue and orange are as luminous as Day-Glo colours. The colours can be changed by altering the controls of your TV set, but the alignment problem cannot be ironed out.

The graphics characters can be printed or Poked on to the screen by using their character codes, but they are also accessible from the keyboard. To print them in, say, a pair of quotes inside a Print statement, you have to press both shift and control at once, then the relevant graphics key. Graphics are printed on the key switches, so you have some idea which one you are using. On the Z key a graphic block is printed which does not correspond to the character printed by that key, and keys: x, c, v, b, are merely repeats of characters that can be found elsewhere and consequently are not marked.

When printed directly from the keyboard the graphics characters appear in the default light and dark green colour set. After a Color command however they will be printed on the screen in that colour. The characters print on to the screen extremely fast in this mode, a thousand colour graphic strings taking less than 20 seconds. But there is a price to pay. A string can only contain graphic characters of one colour, and that colour is always the colour specified by the preceding Color command.

In the text graphics mode, mode 0, the screen is organised into 16 lines of 32 characters. This compares with 24 lines of 32 on the Spectrum — or more correctly 22 usable lines, and 28 by 40 on the Oric — which is a Prestel-like display.

High-Resolution mode, mode 1, is not really high-resolution at all. There are only 128 by 64 pixel locations, which is not much better than some — albeit much more expensive — microcomputers' text mode. This takes up the entire 2K of the video memory, which is interesting because 128 × 64 is not 2K, but 8K.

It works in a way that is similar to the text mode. There are 32 columns and 64 rows, each of which can have any value up to the eight-bit limit of 255. In text mode these normally represent characters, but in mode 1 they represent short graphic strings of four pixels, arranged in a line one after the other. Poking a value into one of these locations specifies the colour of each of those four pixels.

Obviously not all possible combinations of the eight colours in four pixels can be accommodated — there are 4,000. Unfortunately thanks to the colour misalignment, colour is not always visible in this mode.

Light green is the only possible background allowed in the so-called high-resolution mode. To let you know that the mode has changed from low-resolution/text to the pseudo high-resolution the border colour changes from soot black to the same lime green as the rest of the screen. This is to avoid any confusion between what might be called low-resolution 1 and low-resolution 2.

So bad is the colour misalignment that when a sine curve is displayed on the screen, it appears as black on the lime green background, with a hint of whatever the chosen colour was around the edges. This makes a mockery of the TX-8000's ability to display any of its eight colours at any one of the 128 by 64 locations.

Poking to the display is a complicated business in this mode, so there are adequate Basic commands to handle the graphics. They are Set and Reset — which plot and unplot points on the screen, and Point which examines a position and tells you if it is on or off.

Despite the ventilation both in the top of and under the case, the machine can become very hot. This could be due to the poor thermal contact of the heat sink, which was only loosely connected to the power supply semiconductor. This can cause problems. When the machine was turned off momentarily — due to the transformer falling out of the socket — the television had to be retuned to obtain a picture.

TX-8000 Basic is a fairly standard version of Microsoft Basic. It holds few surprises but does have some refinements that, if omitted, would make the Texet a very old-fashioned machine indeed. There is the Step to go with For . . Next, and the Else to supplement the If . . Then. As far as structures go, the TX-8000 is a non-starter.

Cassettes are loaded with the CLoad command, which causes the machine to print Bad on the screen whenever a load fails. Loading is extremely difficult because unlike the Spectrum there is no screen display to let you know how well the load is going.

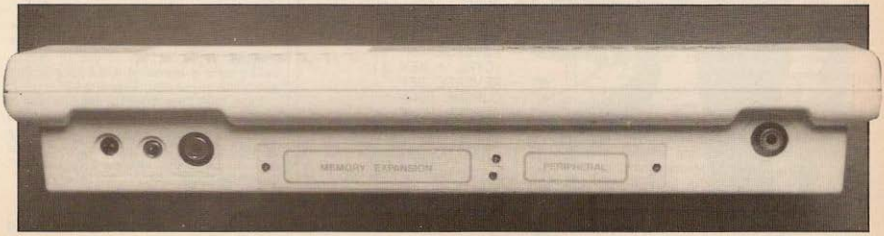
CSave is accompanied by a Verify command, which no self-respecting micro would be seen without these days. All the tape operations are performed at 600 baud which is faster than the ZX-81 but slower than the Spectrum — the Oric allows you to choose speeds. The speed could be at the root of the loading problems but more likely the main offender is the power socket, which is located right next to the cassette socket.

Basic programming lines cannot be longer than two screen lines. If you try entering one longer you simply lose it without warning. The Sound command is feeble compared to the Oric. All it can do is play rather quiet tones — there is no loudspeaker. The Sound command has two parameters, the first being the pitch. This can have any integer value between 1 and 31. If a decimal number is input it simply truncates and plays the next one down. The second parameter is the length of the tone and this is variable between one and nine.

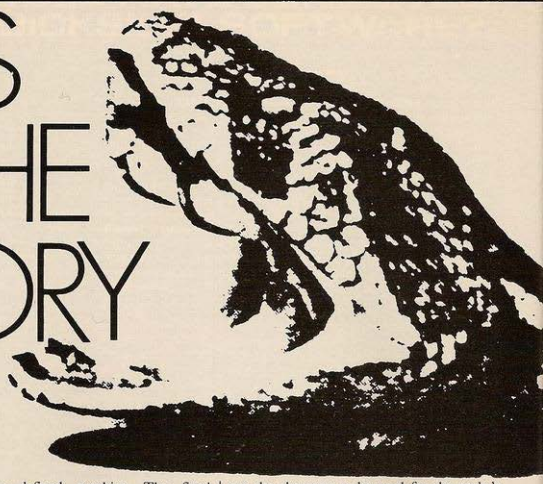
Numbers can only be printed to six significant figures which means that should a business be in such bad shape that it decides to install a TX-8000 as a computer, it will never be able process debts greater than £9,999.99. To ensure neatness trailing zeros are suppressed. ■

CONCLUSIONS

- The Texet TX-8000 may enjoy a brief period of fame as the cheapest colour computer around but too many compromises have been made.
- The colour display on the screen needs tidying up as does the internal construction of the Texet. If this was done then the peripherals available for the TX-8000 — especially 64K expansion for £52 might make it worth a second glance.
- The shortcomings of the £98 Texet make the high standards of the £99 Oric and the £125 Spectrum seem all the more remarkable.



FANGS FOR THE MEMORY — 3·5K



HERE IS AN implementation of Snake for the Vic-20. Although in Basic, it is fast and addictive, and makes good use of defined and multicoloured graphics. The game, admittedly inspired by the veritable plague of ZX Snakes in February's Software File, just squeezes into the basic machine. Little space is left for instructions so do not enter line 10.

Using the S, X, < and > keys you steer the head of a snake. When you first Run the program, you get five seconds grace before the snake automatically moves down the screen.

The object is to clear the screen of flies and beetles. Watch out for the mushrooms though — they are poisonous. Both beetles and flies make the snake grow, but flies more so than beetles. The flies also score more. The more you eat, the faster the snake moves.

If you run into yourself, being a poisonous snake, you will die. One other snag — if you run into the surrounding fence, or try to move alongside yourself, you will find the snake stops, and your score decreases rapidly. And if your score ever gets below zero, the Vic assumes you have committed suicide. This is why you can only move left or down at the start. You could also find yourself boxed in.

Swarm of insects

If you manage to clear the screen, another swarm of insects descends, although the snake stays the same length, and a batch of 10 extra mushrooms grow. The game therefore grows progressively harder.

When the game is over, if you are in the top five scores, you can enter your initials in the Hall of Fame.

This program is a perfect illustration of how straightforward programming coupled with the Vic's excellent graphics and sound capabilities can produce a good enjoyable game.

Here is a breakdown of the program: lines 20-100 initialise it and line 50 lowers RAMtop to protect defined graphics. The fixed graphics characters start at line 60.

S = Segment of snake
M = Mushroom
B = Beetle
F = Fly
W = Wall

At line 100, NM sets the initial number of mushrooms, and Poke V,47 sets the auxiliary colour for the defined graphics used in the program.

Lines 120-140 set up the starting position of the snake's head — HP — and tail — TP — and display it as well as setting its starting direction D and its head character H. Lines 170-190 wait five seconds for a key to be pressed and then continue. Lines 210-250 work out the snake's new direction, depending on which key was pressed, and from that work out the character to be used for the snake's head.

```
THESE ARE SOME OF THE
COLOUR AND CURSOR CONTROL
CHARACTERS USED IN THE
PROGRAM

FOR "▚" READ INVERSE POUND
(CTRL + KEY 5)
"■" - BLACK (CTRL + KEY 1)
"■" - WHITE (CTRL + KEY 2)
"■" - CYAN (CTRL + KEY 4)
"■" - GREEN (CTRL + KEY 6)
"■" - YELLOW (CTRL + KEY 8)
"■" - REVERSE ON
      (CTRL + KEY 9)
"■" - REVERSE OFF
"■" - CURSOR DOWN
"■" - CURSOR HOME
"■" - CLR
"■" - CURSOR RIGHT
"■" - CURSOR LEFT
USE KEYS S AND X FOR UP
AND DOWN
USE KEYS < AND > FOR LEFT
AND RIGHT
```

All the checks on where the snake is are contained in lines 280-310. These lines also verify that the move is allowed, and branch to the appropriate part of the program if necessary.

Line 320 checks if all the beetles and flies have been eaten, and if they have, displays some more. This line also adds 10 more mushrooms. This is the end of the main loop.

Move-snake routine

The move-snake routine is at lines 500-570. It does this by simply moving the snake's head forward and erasing the tail. If the extra-length — EL — variable is greater than zero, it subtracts one from it and skips the erase tail section.

After it has erased the tail, it then looks for a segment next to it, which becomes the new tail. Incidentally, this is the reason why there must always be at least one character between "folds" of the snake as it twists and turns. Otherwise it could confuse this part of the program.

Lines 700-740 and 750-790 are the routines called when either a beetle or a fly is hit. They increase the score and the "extra length" counter.

Lines 800-830 are called when the snake either runs into the wall or tries to move alongside itself.

The score is converted into a six-character string and displayed at lines 900-920.

Lines 1000-1200 define the graphics used in the game, and lines 1500-1590 set up the screen display for the game. The lines starting at 1560 display the mushroom, beetles and flies. Lines 2000-2200 are the "game over" part. The length of the

```
FOR I=1 TO . . . NEXT
```

delay in line 2000 produces an interesting strobe effect. ■

VIC-20

A python can swallow a sheep but this economical program by Andrew Dilley will not put any bulges in your Vic-20. If you're partial to flies and beetles, this is the game for you — but take our advice and lay off the mushrooms.

```
10 REM FOR "■" READ INVERSE POUND SIGN (CNTRL+KEY3)
20 DIMB$(5):FORI=1TO5:B$(I)="000000 ???":NEXT
40 DEFFNR(X)=INT(RND(1)*X)
50 POKE56,29:POKE52,29
60 S=42:M=39:B=40:F=41:W=171
70 TC=7680:CO=30720:S1=36874:S2=S1+2:S3=S2+1:V=S2+2:SR=V+1
80 GOSUB3000
100 NM=20:GOSUB1500:POKEV,47
120 HP=TC+10+22*2:L=5:TP=HP+L:D=22:H=46
140 POKEHP,H:POKEHP+CO,1:FORI=HP+1TOTP:POKEI,S:POKEI+CO,13:NEXT
150 SC=0:GOSUB900
160 PRINT"■■■"TAB(16)LEFT$(B$(1),6);
170 T=TI
180 GETA$:IFA$=""ANDTI-T<300THEN180
190 GOTO210
200 IFSC<0THEN2000
205 GETA$
210 Z=22*(A$="S")-22*(A$="X")+(A$=",")-(A$="."):D=-D*(Z=0)+Z
250 H=-43*(D=1)-44*(D=-1)-45*(D=-22)-46*(D=22)
270 POKEHP,H:NP=HP+D:P=PEEK(NP)
280 IFP=MORP=STHEN2000
290 IFP=WORPEEK(NP+1)=SORPEEK(NP-1)=SORPEEK(NP+22)=SORPEEK(NP-22)=STHENGOSUB800
:GOTO200
300 IFP=BTHENGOSUB700
310 IFP=FTHENGOSUB750
320 IFNB=0ANDNF=0THENNM=10:GOSUB1560:GOTO170
330 GOSUB500:GOTO205
500 POKES1,170
510 POKEHP+CO,13:POKEHP,S:HP=NP:POKEHP+CO,1:POKEHP,H
520 IFEL>0THENEL=EL-1:GOTO550
530 POKETP,32
540 TP=TP-(PEEK(TP+1)=S)+(PEEK(TP-1)=S)+22*(PEEK(TP-22)=S)-22*(PEEK(TP+22)=S)
550 POKES1,0
560 FORT=1TO150-4*L:NEXT
570 RETURN
700 POKESR,12:L=L+1:EL=EL+1
710 X=INT((100+5*L)/10)
720 FORI=1TO10:POKES2,200:POKENP,I+128
730 SC=SC+X:GOSUB900:POKES2,0:NEXT:POKESR,10:NB=NB-1:POKENP,32
740 RETURN
750 POKESR,14:L=L+2:EL=EL+2
760 X=INT((150+6*L)/10)
770 FORI=1TO10:POKES2,220:POKENP,I+128
780 SC=SC+X:GOSUB900:POKES2,0:NEXT:POKESR,10:NF=NF-1:POKENP,32
790 RETURN
800 POKES2,180
810 SC=SC-10:GOSUB900
820 POKES2,0
830 RETURN
900 S$=STR$(SC):Q=LEN(S$):S$=LEFT$("00000",7-Q)+RIGHT$(S$,Q-1)
910 PRINT"■■■■■■"S$
920 RETURN
1000 FORC=35TO46:FORZ=0TO7:READN:POKE7168+8*C+Z,N:NEXT:NEXT
1010 FORZ=8*32TO8*32+7:POKE7168+Z,0:NEXT
1020 RETURN
1100 DATA255,171,171,139,171,171,171,255,255,136,187,139,235,235,136,255
1120 DATA255,136,170,168,170,170,138,255,255,143,191,159,191,191,143,255
1140 DATA56,124,124,254,186,56,56,124,130,84,56,254,56,254,56,254
1160 DATA108,16,124,186,186,186,84,16,40,40,190,190,190,190,40,40
1180 DATA48,104,109,254,254,109,104,48,12,22,182,127,127,182,22,12
1200 DATA36,24,60,126,153,255,126,24,24,126,255,153,126,60,24,36
1500 POKE36869,255
1510 POKESR,10:PRINT"■■■$%&■:"TAB(11)"■#$%&■:"
1520 FORI=0TO21:P1=TC+22+I:P2=TC+22*22+I:P3=TC+22*(1+I):P4=TC+21+22*(1+I)
1530 POKEP1,W:POKEP2,W:POKEP3,W:POKEP4,W:POKEP1+CO,5:POKEP2+CO,5:POKEP3+CO,5:PO
KEP4+CO,5
1550 NEXT
1560 CH=M:C=4:N=NM:GOSUB1700
1570 CH=B:C=5:NB=15:N=NB:GOSUB1700
1580 CH=F:C=7:NF=5:N=NF:GOSUB1700
1590 RETURN
1700 FORI=1TON
1710 P=TC+FNR(20)+1+22*(FNR(19)+3)
1720 IFPEEK(P)<>32THEN1710
1730 POKEP+CO,C:POKEP,CH
1740 NEXT
1750 RETURN
2000 POKES3,200:FORT=1TO250:POKESR,2:FORI=1TO10:NEXT:POKESR,10:NEXT
2050 FORVO=15TO0STEP-.1:POKEV,VO:NEXT
2060 POKES3,0:POKESR,12:POKE36869,240:POKE198,0
2070 PRINT"■■■ KILLED BY A DEADLY":PRINT"■■■ POISONED MUSHROOM "
2080 K=0:FORI=1TO5:IFSC>VAL(LEFT$(B$(I),6))THENK=I:I=5
2090 NEXT:IFK=0THENFORT=1TO1000:NEXT:GOTO2150
2100 PRINT"■YOU ARE ONE OF THE    TOP FIVE PLAYERS"
2110 PRINT"■ENTER YOUR INITIALS■":INPUTI$:IFLEN(I$)>3THEN2110
2120 FORI=4TOKSTEP-1:B$(I+1)=B$(I):NEXT
2130 B$(K)=S$+" "+I$
2150 POKESR,78:PRINT"■"TAB(5)"■HALL OF FAME"
2160 FORI=1TO5:PRINT"■■"I"■"B$(I):NEXT
2170 PRINT"■■■ANOTHER GO(Y/N)■":INPUTY$
2180 IFY$="Y"THEN100
2190 IFY$="N"THENPRINT"■THANKS FOR PLAYING":END
2200 GOTO2170
3000 POKESR,154:PRINT"■■■ S N A K E -- B Y T E "
3020 PRINT"■ USE THESE KEYS:"
3030 PRINT"■■■■■UP■■■■■S■■■■LEFT-■< >■-RIGHT■■■■■■X■■■■■■■DOWN"
3040 PRINT"■■■ EAT THE FLIES &":PRINT"■ BEETLES , BUT BEWARE"
3050 PRINT"■■ THE DEADLY MUSHROOMS"
3060 GOSUB1000
3070 PRINT"■■■ HIT ANY KEY TO START";
3080 GETA$:IFA$=""THEN3080
3090 RETURN
```

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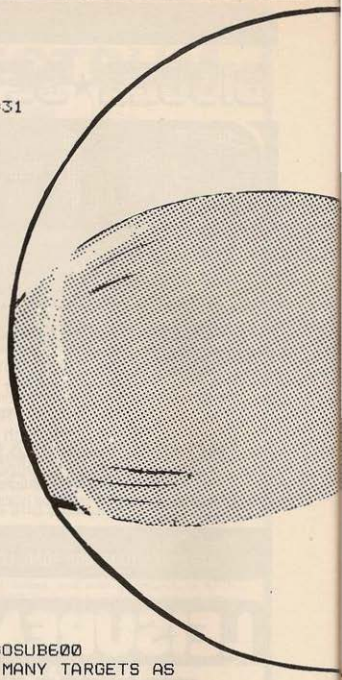
```
10 TIMER=0
20 GOTO320:CLS
30 A1=0
40 CLS:A=1056:Q=RND(7)+1
50 FORI=0TO62:SET(I,A1,Q):NEXT
60 FORI=0TO31:SET((A1*2)-(A1=31),I,Q):NEXT:IFA1=31
   THEN80
70 A1=31:GOTO50
80 L=1138:C=0:B=1:P=0:T=0:Y=48:X=TIMER
90 Z=INT(RND(448))+A+32
100 IFZ=L-B ORPEEK(Z)<>96 THEN90
110 Y=Y+1:POKEZ,Y
120 '
130 A$=INKEY$:IFA$="M" ORA$="Z" THEN270
140 K=PEEK(L+B):IFK<>96 THEN170
150 POKEL,96
160 L=L+B:POKEL,79:GOTO130
170 IF TIMER-X>3600 THEN490
180 IFK=Y ORK>111THEN230
190 C=SGN(B)*(33-ABS(B))
200 Z=87:IFK=111 THENC=-C:Z=43
210 SOUNDZ,1:IFPEEK(L+B+C)<>96 THEN150
220 POKEL,96:L=L+B:B=C:GOTO160
230 IFK=Y THEN250
240 B=-B:SOUND61,1:GOTO150
250 Z=225:FORJ=1TO9:SOUND390-Z,1:NEXT
260 T=T+1:GOTO90
270 C=SGN(B)*(33-ABS(B))
280 Z=78:IFA$="Z" THENC=-C:Z=38
290 IFPEEK(L+C)<>96 THEN150
300 POKEL,111+((A$="M")*19):SOUNDZ,1
310 P=P+1:B=C:GOTO160
320 CLS:PRINT@172,"REBOUND"
330 GOSUB600
340 PRINT:PRINT"   THE ULTIMATE GAME OF SKILL":GOSUB600
350 CLS:PRINT" YOU HAVE ONE MINUTE TO HIT AS"," MANY TARGETS AS
    YOU CAN BY
360 PRINT" PLACING PADDLES IN THE PATH OF";," THE BALL.
370 PRINT:PRINT"  PRESSING 'Z' GIVES YOU '/'
380 PRINT"            'M' GIVES YOU ' ':POKE1242,92
390 PRINT:PRINT" IF YOU USE TOO MANY PADDLES "," YOUR SCORE WILL BE
    REDUCED."
400 PRINT@456,"PRESS ANY KEY"
410 GOSUB610
420 CLS:PRINT" YOU WILL NOT BE ABLE TO HIT ",,," TARGETS WHEN VERY
    CLOSE AND
430 PRINT:PRINT" UNWANTED PADDLES AND TARGETS ",,," MAY BE ERASED"
440 PRINT:PRINT" TO PLAY:-",,,,"  SELECT 'A' FOR AMATEUR",,,"
    'P' FOR PROFESSIONAL
450 PRINT:PRINT"          'N' TO END
460 GOSUB610:IFA$<>"A" ORA$<>"P"THENGOSUB610
470 IFA$="P" THENPOKE65495,0:GOTO30
480 IFA$="A" THEN30
```

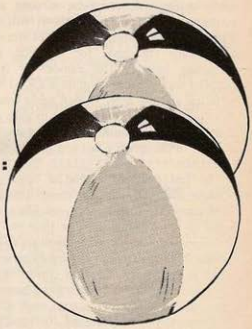


DRAGON

GAMES

You'll have to be fast off the mark to master Vincent Crockett's original game for the Dragon 32. Your quick reflexes come into play as you set the paddles which will send the ball racing towards a new high score. Your targets are the randomly-generated numbers that appear scattered over the screen. Full instructions are included in the program itself. Because Rebound uses Poke locations to increase speed of play, you must finish each game properly and not just stop using the Break key. Remember: you have only one minute per game and if you use too many paddles, your score will be reduced.

```
490 FORZ=250TO4 STEP-6:SOUNDZ,1:NEXT
500 POKE65494,0
510 PRINT@108,"GAME OVER";
520 GOSUB600
530 CLS:PRINT@39,"YOU HIT";T;"TARGETS
540 PRINT@102,"YOU USED";P;"PADDLES
550 S=INT(8000*T/(P+70))/10
560 PRINT@166,"YOUR SCORE IS";S;"%"
570 IFS>HS THENHS=S:Z=200:FORJ=1TO9:Z=350-Z:SOUNDZ,1:
    PRINT@224:PRINT@234,"its a record":FORZ1=1TO30:
    NEXT:NEXT
580 PRINT:PRINT"        HIGH SCORE IS";HS;"%"
590 GOSUB600:GOTO440
600 FORI=1TO2000:NEXT:RETURN
610 A$=INKEY$:IFA$=""THEN610
620 IFA$="N" THENEND
630 RETURN
```



REBOUND

ZX UNIFILE

If your aim is world domination or merely a more organised social life, David Lawrence's versatile program will put your ideas in order.

ONE OF THE dreams that accompanies most micros into the home is the vision of massive information storage. Within weeks, every recipe will be stored, every cheque and bill recorded, phone numbers available at the mere touch of a button. Even if the dream does not turn into a nightmare, it usually fades for two reasons: first, for a great many purposes, the amount of benefit to be gained from putting information on to a micro simply does not justify the amount of work needed to program it in or to retrieve it; and secondly, large masses of information have a nasty habit of resisting all attempts to process them or present them in an orderly fashion — it is all very well storing the whole of the telephone directory on your micro but how do you actually persuade the thing to tell you what you want to know?

The program accompanying this article is directed at 16K ZX-81 owners who have decided that they do want to use their machines for information storage and retrieval but have run up against problems in practice. The system is called Unifile and it is, basically, an empty filing cabinet waiting to be filled with information which it will arrange according to instructions laid down by the user and, equally important, retrieve and display information or amend it.

The Unifile program stores its data in a single string which can be as long as the memory of your expanded ZX-81 will allow. This is not the simplest method of storage by any means. Imagine, for instance, a file consisting only of 100 names. By far the simplest way to store them on a ZX-81 would be to use a string array — each name would be in a clearly definable place and to gain access to any name you would have only to specify its number in the array, a fast and uncomplicated technique.

The real problem is one of space. It is unlikely that you will have many names with 20 characters in them, but if your filing system is not to break down the first time you come across such a name, your array must allow for at least 20 charactes — a 100 by 20 array. The result is that every time you enter "Smith, J H" you have wasted an enormous amount of space in your memory because even with the punctuation you only needed 10 characters of the 20 you have set aside in the array.

If all you have to worry about is one hundred, or even two or three hundred names, then do put them into an array. But what if you wish to add details to the names, so that for each name entered into the file there may be five or six other items of information, all of which will require a space allocation in the array. Space enough in the memory for three hundred names now becomes space enough for only 50 names with their attendant details, assuming that you allow a possible 20 characters for each item of information.

It is for this reason that most computer-filing systems use a storage method which allocates to each item of information only as much space as it actually needs and on the ZX-81 the only way to achieve this end is to pack each item into a string. The technique raises its own problems, as the following example will illustrate.

```
Name: Smith
C/name: John
Address: 12 North St
Town: Anytown
Phone: 0998-11111
Age: 35
Interests: Ferret washing
```

This is a typical entry from an imaginary file and is fairly self-explanatory. Packed into a string, however, it becomes slightly less clear:

```
SMITHJOHN12 NORTH STANYTOWN
0998-1111135FERRET WASHING
```

It may still be decipherable to the human eye, but how is a program searching a string made up of many such entries, packed together, to know where one item begins and another ends. It would be much clearer if we marked each item, at the cost of very little extra space:

```
+SMITH*JOHN*12 NORTH ST*ANYTOWN*
0998-11111*35*FERRET WASHING+
```

We can now instruct our program, when it searches for a particular item, to recognise a plus sign as the beginning of an entry and an asterisk as marking individual items within that entry. Unfortunately such separator symbols can only be recognised if the string of information is examined character by character, which is fine when you are dealing with only a few entries but a little on the slow side if your file has grown to around 10,000 characters.

Some method is needed which allows the program to identify the beginning and end of an entry without examining every character in the file. The Unifile program achieves this by attaching to each entry a special indicator called a "string length indicator", or SLI.

In the case of a small system such as Unifile, the SLI does not need to be able to cope with huge entries and it is, in fact, one character whose Code value is the length of the whole entry.

This limits the length of each entry to 255 characters, or approximately five times as much information as was stored in our specimen entry, which has been found in practice to be adequate.

While the Unifile program cannot jump to the middle of its stored data and unerringly identify the beginning of an entry, using the SLIs it can quickly scan along its files, jumping from one entry to the next at an acceptable speed. A typical Unifile entry would be structured as follows:

a) an SLI recording the length of the whole entry
b) an SLI recording the length of item 1
c) item 1
d) an SLI recording the length of item 2
e) item 2
f) an SLI for the next entry etc.

The Unifile program provides five facilities necessary to operating a useful storage and retrieval system: file structuring, information entry, amendment, search and display. First of all, file structuring. In the specimen entry given above, seven items of information were

ZX-81

recorded about John Smith. The Unifile system allows any number of named items to be specified and any information retrieved later will be reproduced under the specified headings. The only limitation here is that the whole entry must not exceed 255 characters.

As to entry of information, once the types of information to be recorded in each entry have been specified, the program requests entries on the basis of the structure the user has laid down. Entries will be stored in alphabetical order of the first item.

Using the amendment function, individual items can be changed or whole entries deleted.

Two types of search function are provided. For the purposes of a normal search the user specifies an item to be searched for and the program compares this with each item contained in its files. However, only whole items are compared — a normal search would only come up with John Smith if the address being searched for were "12 North Street", it would pass over the entry if the specified address were simply North Street.

Special search, on the other hand, will identify every occurrence of a specified combination of characters such as North Street, or even 'Nor'. Special search is particularly useful for files which do not follow an orderly structure, such as recipes, where it may not be possible to predict precisely how many items of information will be needed and two or more end up being lumped together under the same heading. The disadvantage of special search is that it is considerably slower than normal search. For either form of search, when the specified item is discovered, the whole of the entry containing it is displayed.

The display function displays entries one at a time on command. All the program's functions are called simply from a menu section which is displayed on entry to the program and at relevant points during its use.

The beauty of the Unifile idea is that, once entered on to your ZX-81 and recorded on to a cassette, its uses are endless. A single user can, at one and the same time, be using one version to store his personal address book, with only two or three items per entry, while another version stores vastly more complex club records or business data.

The one major drawback of the program as listed is that it still does not use the memory space available as efficiently as possible — in fact it uses only half the space the ZX-81 would allow. The reason for this is that we have referred to our data storage string on both sides of a string equation, as in line 730. Upon encountering this instruction the ZX-81 promptly sets up a copy of B$ in order that it may maintain a distinction between the new B$ that it is being asked to create and the old B$ it is being asked to use as material. This problem can only be avoided by fixing the length of B$ in the memory of the ZX-81 and working within that fixed length.

The method of doing this, outlined in the supplementary program notes, requires more program lines and is slightly slower in execution. This is because, instead of the economy of line 730, we have now to move B$ in blocks whenever we wish to insert or remove data from the file. This version of the program should only be used, therefore, if you are likely to exceed 4K characters in your intended file. In order to use the second version, B$ must be dimensioned when the file is about to be set up. The maximum length is between 9000 and 9500 characters and to set up a new file simply enter DIM B$(9000) in direct mode, followed by Goto 1. Other than that there is no difference in operation.

395 Size is the variable used to store the number of characters so far recorded in B$.

632 These extra lines check to see whether B$, which is now of fixed length, will be overfilled by the current entry.

730 These two Gosubs replace the sections which added data or subtracted it from B$.

1170 We cannot now use the length of B$ as an indicator that the end of the data has been passed in a search, since no matter how little data is recorded, the length of B$ is static.

1255 This line and 1320 use the spurious entry, inserted into the file when it was first set up, in order to detect the end of the file.

1860 This section — down to 1930 — uses an intermediate string — S$ — to move blocks of B$ up the string, in order to make room for more data. Since B$ does not appear on both sides of a string equation any longer, it is not duplicated in the memory. Slightly more memory can be made available for storage by reducing the value of SHIFT in line 1860 and 1950, though this slows the program down.

1940 This section telescopes the file when an entry is removed and is simply the opposite of the previous section.

```
   1 GOTO 5
   2 SAVE "UNIFILE"
   3 STOP
  40 PRINT "
  50 PRINT ,,"FUNCTIONS AVAILABL
E:"
  60 PRINT ,,"          1)SET UP STRU
CTURE OF FILE."
  70 PRINT ,,"          2)ENTER INFOR
MATION."
  80 PRINT ,,"          3)SEARCH/DISP
LAY/CHANGE."
  90 PRINT ,,"          4)STOP."
 100 PRINT ,,"PLEASE ENTER WHI
CH YOU REQUIRE."
 110 SLOW
 120 INPUT Z
 130 CLS
 140 IF Z=1 THEN GOSUB 250
 150 IF Z=2 THEN GOSUB 420
 160 IF Z=3 THEN GOSUB 1030
 170 IF Z=4 THEN GOSUB 200
 180 CLS
 190 GOTO 40
 200 PRINT AT 10,5;"
 210 PRINT ,,"      *PLEASE RE-RECO
RD IF NEW*"
 220 PRINT " INFORMATION HAS BEE
N ENTERED*"
 230 STOP
 240 REM ***********************
 250 REM ENTRY STRUCTURE
 260 REM ***********************
 270 PRINT AT 0,8;"
 280 PRINT ,,"HOW MANY ITEMS IN
EACH ENTRY?"
 290 INPUT X
 300 CLS
 310 DIM A$(X,20)
 320 PRINT AT 0,6;"
 330 FOR I=1 TO X
 340 PRINT "ITEM ";I;":";
 350 GOSUB 1570
 360 PRINT Q$(2 TO )
 370 LET A$(I)=Q$
 380 NEXT I
 390 LET B$="    "+CHR$ (255)
 400 RETURN
 410 REM ***********************
 420 REM NORMAL INPUT
 430 REM ***********************
 440 LET R$=""
 450 PRINT AT 0,10;"
 460 PRINT ,,"COMMANDS AVAILABLE
:"
 470 PRINT ,,"1)ENTER ITEM SPECIF
IED","2)ENTER ALL" TO QUIT FUNCTI
ON"
 480 PRINT "*******************
**********"
 490 FOR I=1 TO X
 500 GOSUB 1600
 510 GOSUB 1570
 520 PRINT Q$(2 TO )
 530 IF Q$="ZZZ" THEN RETURN
 540 LET R$=R$+Q$
 550 NEXT I
 560 CLS
 570 LET R$=CHR$ (LEN R$+1)+R$
 580 GOSUB 610
 590 GOTO 420
 600 REM ***********************
 610 REM PLACE DATA IN FILE
 620 REM ***********************
 630 FAST
 640 LET C=2
 650 LET C1=C+1
 660 DIM C$(100)
 670 LET D$=C$
 680 LET D$(1 TO CODE R$(2)-1)=R
$(3 TO 1+CODE R$(2))
 690 LET D$(1 TO CODE B$(C1)-1)=
B$(C1+1 TO C1+CODE B$(C1)-1)
 700 IF D$(C# THEN GOTO 750
 710 LET C=C+CODE B$(C)
 720 GOTO 650
 730 LET B$=B$(1 TO C-1)+R$+B$(C
TO )
 740 SLOW
 750 RETURN
 760 REM ***********************
```

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(continued from page 67)

```
770 REM CHANGE ENTRY
780 REM ********************
790 LET C2=C2-1
800 LET C1=C+1
810 LET B$=""
820 PRINT "ENTRY ";C2;":-"
830 FOR I=1 TO X
840 GOSUB 1600
850 GOSUB 1620
860 PRINT AT 17,12;"[illegible]"
870 PRINT "COMMANDS AVAILABLE:"
880 PRINT ">NEWLINE LEAVES ITEM
UNCHANGED","><"ZZZ"" DELETES WH
OLE ENTRY","><ENTER NEW ITEM"
890 GOSUB 1570
900 IF Q$="" THEN LET R$=R$+B$
(C1 TO C1+CODE B$(C1)-1)
910 LET C1=C1+CODE B$(C1)
920 CLS
930 IF Q$="" THEN GOTO 960
940 IF Q$="ZZZ" THEN GOTO 970
950 LET R$=R$+Q$
960 NEXT I
970 LET B$=B$(1 TO C-1)+B$(C+CO
DE B$(C) TO )
980 IF Q$="ZZZ" THEN RETURN
990 LET R$=CHR$ (LEN R$+1)+R$
1000 GOSUB 610
1010 RETURN
1020 REM ********************
1030 REM SEARCH
1040 REM ********************
1050 LET C=2
1060 LET C4=0
1070 LET C2=1
1080 PRINT AT 0,14;"[illegible]"
1090 PRINT ,,"COMMANDS AVAILABLE
:"
1100 PRINT ">INPUT ITEM FOR NORM
AL SEARCH",">PRECEDE WITH ""SSS"
" FOR","SPECIAL SEARCH",,">PRECE
DE WITH ""III"" TO SEARCH","FOR
1ST CHARACTER OF ENTRY"
1110 PRINT ">NEWLINE FOR 1ST ITE
M ON FILE"
1120 PRINT "*******************
************"
1130 PRINT ,,"INPUT SEARCH ITEM:
";
1140 GOSUB 1570
1150 LET S$=Q$
1160 IF S$="" THEN GOTO 1310
1170 IF C+2=LEN B$ THEN RETURN
1180 FAST
1190 LET C1=C+1
1200 IF LEN S$<4 THEN GOTO 1240
1210 IF S$(2 TO 4)="SSS" THEN GO
SUB 1730
1220 IF S$(2 TO 4)="III" THEN GO
SUB 1730
1230 IF C4=1 THEN GOTO 1310
1240 FOR I=1 TO X
1250 IF B$(C1 TO C1+CODE B$(C1)-
1)=S$ THEN GOTO 1310
1260 LET C1=C1+CODE B$(C1)
1270 NEXT I
1280 LET C=C+CODE B$(C)
1290 LET C2=C2+1
1300 GOTO 1170
1310 LET C1=C+1
1320 IF C+2=LEN B$ THEN RETURN
1330 CLS
1340 SLOW
1350 PRINT "ENTRY ";C2;":-"
1360 GOSUB 1640
1370 LET C2=C2+1
1380 PRINT AT 16,12;"[illegible]"
1390 PRINT "COMMANDS AVAILABLE:"
1400 PRINT ">NEWLINE TO DISPLAY
NEXT ITEM",">""ZZZ"" TO QUIT FUN
CTION",">""AAA"" TO AMEND",,">""
CCC"" TO CONTINUE"
1410 INPUT P$
1420 CLS
1430 IF P$="CCC" THEN GOTO 1170
1440 IF P$="" THEN GOTO 1310
1450 IF P$<>"AAA" THEN GOTO 1510
1460 LET C=C-C3
1470 LET C4=C
1480 CLS
1490 GOSUB 770
1495 LET C2=1
1500 LET C=2
1510 IF P$="ZZZ" THEN RETURN
1520 CLS
1530 GOTO 1170
1540 REM ********************
1550 REM FUNCTIONAL SUBROUTINES
1560 REM ********************
1570 INPUT Q$
1580 LET Q$=CHR$ (LEN Q$+1)+Q$
1590 RETURN
1600 PRINT A$(I,2 TO CODE A$(I,1
));":";
1610 RETURN
1620 PRINT B$(C1+1 TO C1+CODE B$
(C1)-1)
1630 RETURN
1640 FOR I=1 TO X
1650 GOSUB 1600
1660 GOSUB 1620
1670 LET C1=C1+CODE B$(C1)
1680 NEXT I
1690 LET C3=CODE B$(C)
1700 LET C=C+CODE B$(C)
1710 RETURN
1720 REM ********************
1730 REM SPECIAL SEARCH
1740 REM ********************
1750 LET C4=0
1760 FOR J=C+2 TO C+CODE B$(C)-L
EN S$+5
1770 IF S$(2 TO 4)="III" AND J>C
+2 THEN GOTO 1820
1780 IF B$(J TO J+LEN S$-5)<>S$(
5 TO ) THEN GOTO 1810
1790 LET C4=1
1800 RETURN
1810 NEXT J
1820 RETURN
```

Two subroutines to be added.

```
1830 REM ********************
1840 REM MOVING DATA
1850 REM ********************
1860 LET SHIFT=512
1870 FOR I=LEN B$-LEN R$ TO C ST
EP -SHIFT
1880 IF I-SHIFT<C THEN LET SHIFT
=I-C
1890 LET S$=B$(I-SHIFT TO I)
1900 LET B$(I-SHIFT+LEN R$ TO I+
LEN R$)=S$
1910 NEXT I
1920 LET B$(C TO C+LEN R$-1)=R$
1930 RETURN
1940 FAST
1950 LET SHIFT=512
1960 LET SIZE=SIZE-CODE B$(C)
1970 FOR I=C+CODE B$(C) TO LEN B
$ STEP SHIFT
1980 IF LEN B$-I+1<SHIFT THEN LE
T SHIFT=LEN B$-I+1
1990 LET S$=B$(I TO I+SHIFT-1)
2000 LET B$(C TO C+SHIFT-1)=S$
2010 LET C=C+SHIFT
2020 NEXT I
2030 RETURN
```

These lines complete the change.

```
390 LET B$(1 TO 4)="  "+CHR$ (
255)
395 LET SIZE=5
425 PRINT "FILE SIZE:";SIZE;"/"
;LEN B$
632 LET SIZE=SIZE+LEN R$
634 IF SIZE<=LEN B$ THEN GOTO 6
40
636 PRINT AT 14,10;"FILE NOW FU
LL"
638 LET SIZE=SIZE-LEN R$
639 RETURN
730 GOSUB 1660
970 GOSUB 1940
1170 REM DELETE THIS LINE
1255 IF B$(C1 TO C1+CODE B$(C1)-
1)="  COPY  " THEN RETURN
1320 IF B$(C1 TO C1+CODE B$(C1)-
1)="  COPY  " THEN RETURN
```

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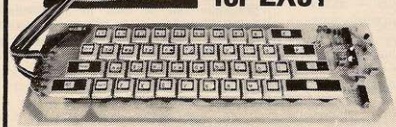

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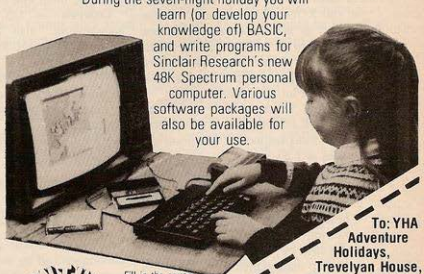

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BBC

Chris Melville plunges into the BBC's MOS — the handy machine-code routines already inside the Micro.

DIG INTO OPERA SYSTE

LAST MONTH I looked at the machine-level programming of the BBC using its assembler. This month I will deal with the useful machine-code routines already inside the firmware of the machine — that is, the Machine Operating System or MOS.

There are several slightly differing operating systems available, each one an improvement on the last. To identify your operating system, type:

```
*FX 0
```

and then press Return.

Operating systems around at the moment include the OS 0.1 — the first issue and the most common, sadly bug-ridden and lacking several important features such as the ability to drive discs, support extra paged ROMs, receive data on the RS-423 port and several important input-output routines. The OS 1.0 is a revision of 0.1, and can handle discs, paged ROMs, RS-423 reception, and has a full complement of system routines, although there are still some minor bugs.

There were then various issues with minor differences until the OS 2.1 — the one now being put on ROM. This features all the features of 1.0 as well as some useful new graphics routines to be used as starting points for sophisticated shape-filling algorithms. These will be incorporated into Issue 2 Basic as an extra set of Plot commands.

When referring to the MOS, I will be referring to OS 0.1 since this is compatible with the rest in most respects. I will point out any differences as I go.

The operating system of the BBC computer is a set of routines which control the input-output and housekeeping functions of the micro. These include VDU drivers for printing, plotting — that is, everything that can be performed by the VDU function in Basic; sound-chip management — the routines that control the operation of the sound chip as specified in Basic Sound and Envelope statements; cassette filing system operations; and keyboard handling. The routines form a central core around which the high-level language interpreter operates, as shown in figure 1.

Since the MOS routines are powerful tools for the assembly language programmer as well as the machine's own interpreter, Acorn was careful that they were made as accessible as possible. There are several entry points to the MOS. Since the MOS is so big — around 16K — and contains so many routines, it was necessary to provide a modified method of calling these routines, rather than the straightforward listing of a suitable calling address for each routine.

The MOS is divided into 13 sections, each performing a particular task or collection of tasks, each of which has an address to which an assembly language, JSR or Basic Call,USR can refer.

Where there are several tasks to a section, it is necessary to specify which one is being called by placing an identification number in the accumulator just before executing the call. Figure 2 is a comprehensive summary of the OS features.

The sections that comprise the MOS are shown in the left-hand column of figure 2. We will take them one by one.

Oswrch — OS WRite CHaracter in accumulator: also known as the "VDU driver", this section is responsible for the input-output to the VDU — which includes the 32 ASCII control characters as well as the printable character set.

The Basic statement VDU a,b,c,. . . is equivalent to:

```
A%=a : CALL OSWRCH : A%=b : CALL
  OSWRCH
```

or

```
LDA#a : JSR OSWRCH : LDA#a : JSR
  OSWRCH
```

in Basic and assembler respectively.

This is obviously a very powerful routine because it means that all Basic screen commands can be written as a series of VDU commands and therefore all can be easily performed at assembly-language level.

Suppose, for example, we wished to do the following sequence of operations in assembly language:

1. Select mode 2 — mode 2 in Basic is equivalent to VDU 22,2
2. Set graphics foreground colour red — GCOL 0,1 which is equivalent to VDU 18,0,1.
3. Draw a line between (100,100) and (300,200). The latter is done by

```
MOVE 100,100 : DRAW 300,200
```

or

```
VDU 25,4,100;100;25,5,300;200;
```

which is again the same as

```
VDU 25,4,100,0,100,0,25,5,44,1,200,0
```

The operations can be written as one long VDU statement:

```
VDU22,2,18,0,1,25,4,200,0,100,0,25,5,44,1,200,0
```

Which is easily written in assembly language:

```
LDA#22 : JSR OSWRCH : LDA #18 : JSR
OSWRCH : LDA#0. . . etc
```

Or, to make it more tidy and less bulky:

```
FOR x%=1 TO 17
READ a%
[: LDA#a% : JSR OSWRCH :]
NEXT x%
DATA 22,2,18,0,1,25,4,200,0,100,0,25,5,44,
1,200,0
```

Outputting prompts or messages from a machine-code program can be a tedious business on a bit-mapped machine like the BBC, but again the Oswrch routine helps make light work of this. The following procedure can be used in an assembly-language program to generate the code to output a message, which is passed to the procedure as a string paramêter:

```
DEF PROCMESSAGE(x$)
  LOCAL i%
  FOR i%=1 TO LEN (x$)
    [: LDA#ASC(MID$(x$,i%,1)) : JSR
    OSWRCH :]
  NEXT i%
ENDPROC
```

Of course, before you can call Procmessage you must leave the assembler and then re-enter it after the call. The procedure generates five bytes of code for every character in the message, so ensure you have reserved enough memory.

Oswrch, and all the other Osnames, is not a defined constant. You should set it at the beginning of a program and use it to aid readability. The actual value it has varies from one MOS issue to the next but you can set it so that it does not matter which MOS you have. This is done by:

```
OSWRCH=!&20E AND &FFFF
```

The reason for this obscure-looking command will become clear later.

Osbyte — OS routines that use the processor's registers to pass byte-size parameters. We have seen how the entire

O THE ATING M

range of VDU commands can be performed by a call to Oswrch but these do not constitute the entire range of screen-handling facilities provided by Basic, such as altering the flash-rates of colours and seeing what character lies at the position of the text cursor. These are all performed in Basic by the *FX command, which also controls many other machine functions not connected with the screen — see page 418 of the manual. The Osbyte routines provide the entire range of *FX commands in the same way as Oswrch did the VDUs, though this time there are many differing routines and we choose which one we want by placing an identification number in the accumulator prior to the call. In common with the VDU statement, the *FX statement may have more than one parameter, for example:

```
*FX 12,50
```

sets the keyboard auto-repeat to half a second. However, there are never more than three parameters so the entire statement can be performed in one go by passing the parameters in the A,X and Y registers of the 6502A. This avoids the need for repeated calling, necessary in the Oswrch section. For the call

```
*FX a,b,c
```

a is the call number and is passed in the accumulator; b is the first parameter, present on the most calls, and is passed in the processor's X register; c is the second parameter, only present on a few calls, and is passed in the Y register. So the

```
*FX 12,50
```

call would be done as follows:

```
LDA # 12 : LDX # 50 : JSR OSBYTE
```

Osbyte having been previously defined. In some cases success/failure indicators or results are returned in the register. You should consult the manual to see further. The value of Osbyte is set by

```
Osbyte = ! &20A AND &FFFF
```

Osword — OS routines whose parameters are taken from specified words or memory. So far we can perform a large range of useful functions using Oswrch, where each call provides one parameter in the accumulator, and Osbyte, where each call gives up to three parameters in the processor's only three registers. There are a few more important features we would need regularly that need a lot more specified parameters than either Oswrch or Osbyte. For example it is vital that the OS provides sound-generating routines otherwise we would be left to manipulate the sound chip's registers ourselves if we required sound to be produced from a machine-code program. However the Basic's Sound and Envelope statements need a lot of parameters — far too many to be passed in the A,X,Y registers of the processor. The technique used to make these Osword calls is to use the A register as before — that is, to identify the function required — see figure 2 — and to pass the Address of a block of locations in RAM where we have previously stored the parameters in a predefined order in the X register — low byte — and Y register — high byte. A good example of this process is sound generation.

Oswrch, Osbyte and Osword are by far the most useful MOS sections to the assembly language programmer but for completeness I will briefly describe the other MOS parts.

Osrdch — this MOS section deals with inputting characters from the keyboard. This is not really as useful as it sounds since most purposes will require that typing ahead has no effect and so an Osbyte call of 129 would be a better method. Contrast this to the two forms of Inkey statements — a negative argument tests whether a key is held at that instant.

```
OSRDCH = !&210 AND &FFFF
```

is the prefered definition of the address.

Osfind, Osgbpb, Osbput, Osbget, Osargs, Osfile — these are all calls to deal with the setting up of a data file on the current filing system, and then performing transfers to and from it.

Osnewl — this simply causes a new line to be started on the screen

```
OSNEWL = &FFE7
```

Osasci — equivalent to Oswrch except that a line feed is issued if, on calling, the accumulator contains &0D.

```
OSASCI = &FFE3
```

Oscli — This provides another way of calling MOS routines. If, on calling Oscli, the 6502A's X and Y registers point to the start of a command line in memory. Suppose we had

```
TV 0,255
```

stored in succesive bytes from location &2345 then we would put &45 into X and &23 into Y. Then the command line interpreter will interpret and execute the command.

```
OSCLI = ! &208 AND &FFFF
```

That concludes the machine-operating system sections. At this point it would be wise to point out that there is a price to be paid for all the power and flexibility of the routines provided by the MOS and it is speed. A little time must be taken for the MOS to examine your call and cause execution of the correct routine inside of the section you have called to. However, this may not be such a disadvantage since the chances are that, should you have written your own routine to do the job, it would not be as efficiently coded as those inside the MOS and would thus be slower anyway.

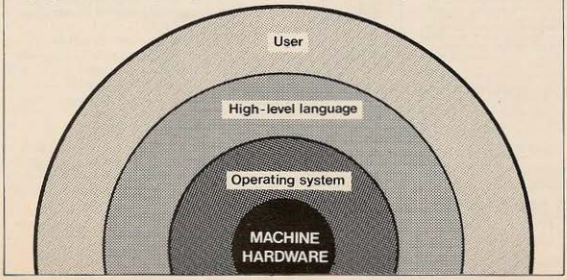
Up until now we have assumed that when we execute a call such as JSR Oswrch — with Oswrch defined as &FFEE — the program flow goes directly to &FFEE and the routine starts there. This raises an immediate problem; when a second processor is fitted the whole memory-map of the machine changes and it can no longer be guaranteed that the routine actually begins at &FFEE in the second processor.

Similarly, if you were to update your OS to the latest version, it would be highly unlikely that that particular routine was still held at the same starting address. In both cases, any calls such as the above would fail and therefore the program would fail also, unless it was modified suitably. These problems are neatly avoided by introducing indirection into the call mechanism. In simple terms, the real sequence of events when we call a MOS routine is: first, we make our call, as before, to an address in the range &FF00 to &FFFF. Second, the operating system then looks at two consecutive bytes in RAM and from them obtains a 16-bit address previously put there by the bootstrap on power-up or Break. This address may change from machine to machine depending on the MOSs and whether or not second processors are fitted, but it always points to the start in memory of the code that performs the routine we originally wanted. This 16-bit RAM-held address is called the Vector for that particular call. Third, the routine can now be performed by jumping to the address given by the vector.

Although all of the vectors are originally set at power-up, since they are held in RAM there

(continued on next page)

Figure 1. The user relates to the operating system via the Basic interpreter. The high-level language relates to the operating system via machine code, but using pre-written OS routines.



(continued from previous page)
is nothing to stop us changing them so that they point to our own routines in RAM. We could then write routines which completely replace those in the MOS.

I will now demonstrate writing a routine which performs a small operation before branching to the address that was the original vector. This program will cause the BBC to beep every time a key is pressed on the keyboard. First of all we have to be able to produce a Beep in machine code, which is achieved using a call to the Osword routine for sound generation. The stages for this are first, set up a parameter block — this can be done in Basic at the start:

```
10 DIM PARAM% 7 : OSWORD=! (&20C)
   AND &FFFF
20 FOR i%=1 TO 8
30 READ p% : ? (PARAM%+i%-1)=P%
40 NEXT
50 DATA &11,0,&F6,&FF,&14,0,2,0
```

See page 461 of the manual to see how a sound parameter block should be arranged. The Data statement gives rise to the parameters equivalent to those in the Sound statement:

```
SOUND &11,-10,20,2
```

Assemble the code to call up the sound routine in Osword:

```
 70 DIM P% 30
 80 |
 90 .beep PHA:TXA:PHA:TYA:PHA
100 LDA# 7
110 LDX# PARAM% MOD 256
120 LDY# PARAM% DIV 256
130 JSR OSWORD
140 PLA:TAY:PLA:TAX:PLA
150 RTS
160 |
```

Run this program and then do Call Beep and you should hear a short tone. Lines 90 and 140 Save and Restore the A,X,Y registers, since this will be necessary in the full program.

We must now decide how to arrange things so that the subroutine Beep gets called every time a key is pressed. When a key is pressed, three things happen, one, an interrupt tells the processor that this has occurred; two, the MOS uses its Osrdch routine to take this character from the keyboard; three, the character is possibly echoed to the screen and further action may be taken.

Since two and three involve Operating System calls, we could intercept them by changing the vector of which one we choose so that it points to Beep. It turns out that it is best to choose number two. Three further modifications are required to complete the program. Save the value of the Osrdch vector so that the proper Osrdch routine can still be called at the end of the beep routine.

```
60 v%=! (&210) AND &FFFF
```

Now call the real Osrdch routine after our Beep routine so that the proper things still happen when we press a character.

```
145 JSR v%
```

The Basic program should change the Osrdch vector to point to Beep, but only after its old value has been saved.

```
170 ?(&210)=BEEP MOD 256 :?(&211)=BEEP
DIV 256
```

The program can now be run and deleted; the key-beep will remain. Although not very practical in itself, this is a good illustration of the way in which it is possible to use a little ingenuity to attain a desired effect. ■

MOS section	Address	Vector	Function	Routines inside
OSGBPB	&FFD1	21A	Load/Save Memory	
OSFIND	&FFCE	&21C	Opening files	Open for read (&40), Open for Write (&80) Close (0), Open for Read and Write (&c0)
OSBGET	&FFD7	&216	Reads Byte	—
OSBPUT	&FFD4	&218	Writes Bytes	—
OSARGS	&FFDA	&214	Attributes —	
OSFILE	&FFDD	&212	R/W Files	Contents of accumulator decide what to Read/Write
OSRDCH	&FFE0	&210	Reads from Input Stream (IS)	
OSWRCH	&FFEE	&20E	Writes to IS	Causes output of character or control code whose ASCII code is in accumulator
OSASCI	&FFE3	none	Writes to IS	As above, but new line if accumulator = &0D
OSNEWL	&FFEE	none	Writes to IS	Outputs line feed, carriage return only
OSWORD	&FFF1	&20C	Miscellaneous	Reads line from input stream to RAM (0) Reads internal clock (1) Writes internal clock (2) Reads interval timer (3) Writes interval timer (4) Reads a byte across the Tube (5) Writes a byte to processors memory across Tube (6) Performs sound (7) Envelope definition (8) Reads a pixel colour at specified position (9) Reads dot pattern on non-control character (A) Returns palette/logical colour relationship (B)
OSBYTE	&FFF4	&20A	Effects	The following are in numerical order of accumulator contents. Prints MOS report — Choose input stream Choose output stream Enable or disable cursor edit keys (4) Parallel or serial printer select Define printer, ignore character Set serial port receive rate (7) Set serial port transmit rate Select flash speed of foreground colour (9) .....Background..... Miscellaneous enables .....disables Empty buffers Select ADC channel number (16) Starts analogue-to-digital conversion Clear soft keys Pause until fields are synchronised Explode user-definable key memory Empty chosen buffer Cancel escape condition (124) Set escape condition Acknowledge presence of escape condition (126) Select base number for soft-key codes .....shift..... .....control..... .....shift/control..... Perform escape enable/disable escape key .....interrupt request for user 6522 .....ACIA 6850
OSCLI	&FFF7	&208	Interpreting command line	

Figure 2: Summary of facilities offered by operating systems 1.0 and above. The call numbers for the routines inside are shown in brackets.

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```
10 REM ##################
20 REM ##                ##
30 REM ##  S.O. 6/82     ##
40 REM ##################
49 REM VBI AND DLI ROUTINES
50 FOR I=1536 TO 1613:READ A:POKE I,A:NEXT I:POKE 206,4:POKE 207,4:A=USR(1536)
60 DATA 104,160,10,162,6,169,7,76,92,228,173,199,2,205,200,2,240,16,198,207,208,25,169,5,133,206
70 DATA 173,200,2,141,199,2,208,13,198,206,208,9,169,10,133,207,165,208,141,199,2,169,0,133,209,
76,98,228
80 DATA 72,138,72,166,209,189,75,6,141,10,212,141,26,208,232,134,209,104,170,104,64,155,152,24
89 REM CHANGE CHARACTER SET
90 GOSUB 3000
99 REM STRINGS HOLDING PRINT POS.
100 DIM C$(7),X$(7),Y$(7),X5$(7),Y5$(7),X7$(7),Y7$(7),X6$(7),Y6$(7),X14$(7),Y14$(7),X10$(7),Y10$
(7)
105 DIM X11$(7),Y11$(7),X9$(7),Y9$(7),BX(7),BY(7)
110 FOR I=1 TO 7:X5$(I)=CHR$(B+I):Y5$(I)=CHR$(B+I):X7$(I)=CHR$(B+I):Y7$(I)=CHR$(9):X6$(I)=CHR$(B
+I)
115 Y6$(I)=CHR$(10-I):X14$(I)=CHR$(9):Y14$(I)=CHR$(10-I):X10$(I)=CHR$(10-I):Y10$(I)=CHR$(10-I)
120 X11$(I)=CHR$(10-I):Y11$(I)=CHR$(9):X9$(I)=CHR$(10-I):Y9$(I)=CHR$(B+I)
129 REM CHOOSE INPUT DEVICE
130 GRAPHICS 18:POKE 756,START/256:NEXT I:POSITION 6,3:? #6;"choose":POSITION 4,5:? #6;"1 paddle
"
131 REM 'paddle' & 'joystick' IN INVERSE CHAR.
135 POSITION 8,6:? #6;"or":POSITION 4,7:? #6;"2 joystick":OPEN #1,4,0,"K"
140 GET #1,A:IF A<49 OR A>50 THEN 140
150 POSITION 9,9:? #6;CHR$(A):INDEV=A-48
199 REM PROGRAM INITIALIZATION
200 DIM F(7),ST$(10),BP$(4):BP$="burp":MAXWAIT=6:MAXBUG=30
210 RESTORE 220:FOR I=1 TO 10:READ A:ST$(I)=CHR$(A):NEXT I
220 DATA 7,5,6,0,1,3,2,0,4
280 POKE 208,37:S=1:REM 208 IS BUG COLOR
285 REM INITIAL DIFFICULTY SELECTION
286 GRAPHICS 1:POKE 708,229:POKE 712,155:GOSUB 700:GOSUB 400
289 REM RESTART GAME
290 FOR I=1 TO 7:F(I)=0:NEXT I:SCORE=0:NUMBUG=0:BONUS=50
300 GRAPHICS 1:POKE 756,START/256:GOSUB 700:X$=X5$:Y$=Y5$:POKE 708,229:POKE 709,54:POKE 710,227:
POKE 712,155
305 REM DRAW
306 GOSUB 2000:POSITION 8,5:GOSUB 905
308 REM MAIN LOOP
309 IF INDEV=2 THEN GOSUB 500:GOTO 320
310 S=INT((PADDLE(0)-45)/20):IF S>7 THEN S=7
312 IF S<1 THEN S=1
314 S=8-S
320 POSITION 8,5:GOSUB 900+S
325 IF INDEV=2 AND STRIG(0)=0 THEN GOSUB 1000
330 IF INDEV=1 AND PTRIG(0)=0 THEN GOSUB 1000
339 I=0:IF WAIT>1 THEN WAIT=WAIT-1:GOTO 350
340 WAIT=MAXWAIT
341 I=I+1:IF I=8 THEN 350
342 IF F(I)=0 THEN 341
345 IF F(I)=2 THEN 347
346 RESTORE 800+I:READ DX,DY,BX,BY:POSITION BX,BY:? #6;CHR$(129):F(I)=2:BX(I)=BX:BY(I)=BY:GOTO 3
41
347 RESTORE 800+I:READ DX,DY:POSITION BX(I),BY(I):? #6;" ":BX(I)=BX(I)+DX:BY(I)=BY(I)+DY
348 POSITION BX(I),BY(I):? #6;CHR$(129):IF BX(I)>5 AND BX(I)<13 AND BY(I)>5 AND BY(I)<11 THEN 37
0
349 GOTO 341
350 IF BUG>1 THEN BUG=BUG-1:GOTO 360
352 BUG=MAXBUG:IF NUMBUG=7 THEN 360
354 I=INT(RND(0)*7)+1:IF F(I)>0 THEN 354
356 F(I)=1:NUMBUG=NUMBUG+1
360 GOTO 309
369 REM BUG GOT TO FROG
370 POSITION 8,5:? #6;". .":FOR I=1 TO 6:POKE 708,38:SOUND 0,100,12,10:FOR J=1 TO 50:NEXT J
375 POKE 708,36:SOUND 0,150,12,10:FOR J=1 TO 10:NEXT J:NEXT I:SOUND 0,0,0,0
398 GOSUB 400:GOTO 290
399 REM PROMPT FOR NEW GAME
400 POSITION 4,13:? #6;"PRESS start":POSITION 6,14:? #6;"TO PLAY":REM USE IN INVERSE CHAR. IN TH
ESE TWO LINES
401 POSITION 4,16:? #6;"PRESS select":POSITION 3,17:? #6;"FOR DIFFICULTY"
402 POKE 53279,8:K=PEEK(53279):IF K=6 THEN 420
404 IF K<5 THEN MAXWAIT=MAXWAIT-1:MAXBUG=MAXBUG-5:IF MAXBUG<5 THEN MAXBUG=30:MAXWAIT=6
406 POKE 656,0:POKE 657,3:? 7-MAXWAIT
408 FOR I=1 TO 100:NEXT I
410 GOTO 402
420 POSITION 5,16:? #6;"          ":POSITION 3,17:? #6;"                "
430 IF SCORE>MAXSCORE THEN MAXSCORE=SCORE
440 RETURN
499 REM JOYSTICK SUBROUTINE
500 S0=STICK(0):IF S0=15 OR S0=13 THEN RETURN
510 S=ASC(ST$(S0-4)):RETURN
599 REM BURP SUBROUTINE
600 POKE 77,0:X=1:Y=0:FOR K=1 TO 4:X=X+1:Y=Y+1:POSITION X,Y:? #6;BP$(K,K):NEXT K
620 FOR K=250 TO 150 STEP -3:SOUND 0,K,2,10:NEXT K
630 X=1:Y=0:FOR K=1 TO 4:X=X+1:Y=Y+1:POSITION X,Y:? #6;" ":NEXT K:RETURN
699 REM CHANGE DISPLAY LIST
700 A=PEEK(560)+256*PEEK(561):POKE A+3,198:POKE A+15,134:POKE A+24,134
710 IF PEEK(A)<>66 THEN A=A+1:GOTO 710
720 POKE A,71:POKE A+3,7:POKE A+4,65:POKE A+5,PEEK(A+7):POKE A+6,PEEK(A+8)
722 POKE 512,54:POKE 513,6:POKE 54286,192
730 POKE 656,0:POKE 657,3:? 7-MAXWAIT:POKE 656,0:POKE 657,15:? MAXSCORE
740 POSITION 2,19:? #6;"dif  score  high":RETURN
800 REM X-Y INCREMENTS & STARTING POS.
801 DATA 1,-1,0,18
802 DATA 1,0,0,9
803 DATA 1,1,0,0
804 DATA 0,1,9,0
805 DATA -1,1,18,0
806 DATA -1,0,18,9
807 DATA -1,-1,18,18
900 REM PRINT EYES ON FROG
901 X$=X9$:Y$=Y9$:? #6;") )":RETURN
```

CRA
OLD
TOA

Gulp down those bugs as you drift lazily on your lily-pad with Stan Ockers' game for the Atari.

YOU PLAY the part of an extremely hungry toad. Your object is to eat all bugs before they reach you by pointing the toad's beady eyes at the incoming bug. You will find that your tongue snakes out and slurps up the bugs when you press the Fire button. Points are scored depending on the difficulty level. However, if the bug hits you, you die. The level of difficulty can be set at the start of the game. Either a joystick or paddle controller can be used.

The bugs are made to blink on and off by a Vertical Blank Interrupt — VBI — routine that changes the bugs' colour to background colour and back. The VBI routine also has an important function in connection with another routine, the Display List Interrupt routine.

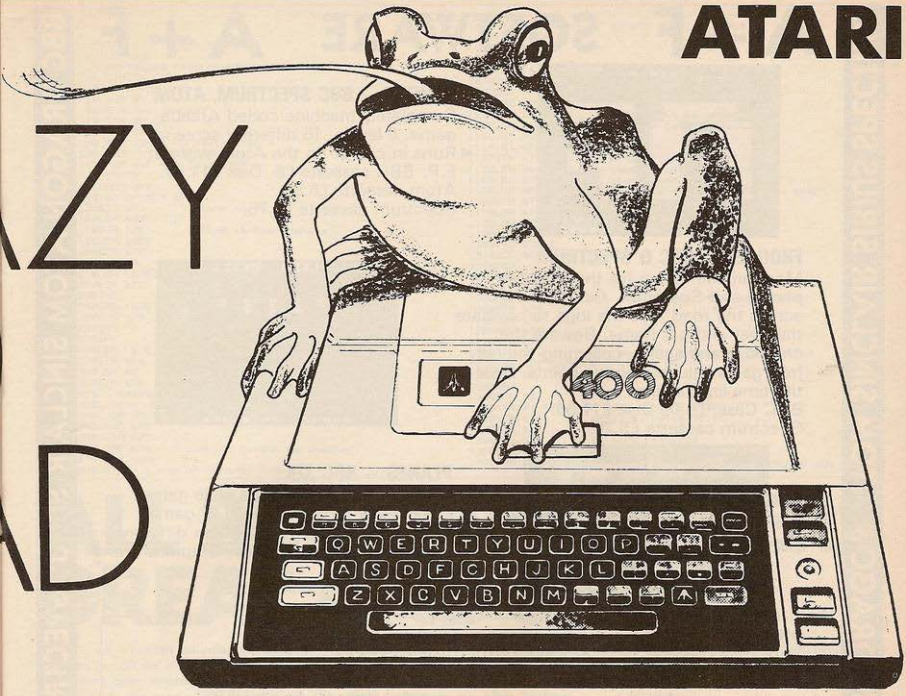
The display list is modified, lines 700-720, to change the text area to two mode 2 lines and also to set display list interrupts at three points down the vertical height of the screen. When these interrupts occur the DLI routine changes the background colour depending on a counter which counts the DLIs. During the vertical blank period this counter is reset to zero, ready for the next screen. This technique gives separate colours to the sky, water and score areas.

The character set has been altered enabling the toad to be printed in graphics mode 1. This

ATARI

ZY

AD



gives a choice of upper case and punctuation or lower case and graphics symbols. It is best to pick the former and change the punctuation starting with that above the numerals on the keyboard, leave the quotation mark alone. The set must first be moved from ROM to RAM and I use a machine-code routine stored in ZZ$ to do this — line 3000.

To move the tongue around, keep track of the print positions. I put these locations in strings; a set of Xs and Ys for each direction — lines 100-120. The positions are recovered from the strings by using the ASC function — lines 1002 and 1004.

Atari Basic can restore data values to the beginning of a certain line. This function is used in picking up the starting position and increments of the bugs — 346 to start or line 347 to continue — flags — F(I) — keep track of the condition of the bugs; 0 means the bug is active, 1 it is in motion and 2 means that it collided with something.

Wait and Bug are counters that skip over the start-a-bug and move-bug sections. When the counters reach zero, a new bug is started or all the bugs are moved and the counters are set to Max Wait, Max Bug respectively. The larger these maximums, the slower things go and the difficulty level is increased by reducing Max Wait and Max Bug. ■

```
902 X$=X11$:Y$=Y11$:? #6;"( (":RETURN
903 X$=X10$:Y$=Y10$:? #6;"@ @":RETURN
904 X$=X14$:Y$=Y14$:? #6;"$ $":RETURN
905 X$=X6$:Y$=Y6$:? #6;"% %":RETURN
906 X$=X7$:Y$=Y7$:? #6;"& &":RETURN
907 X$=X5$:Y$=Y5$:? #6;"' '":RETURN
999 REM TONGUE ROUTINE
1000 I=0
1001 I=I+1:IF I=8 THEN 1010
1002 POSITION ASC(X$(I)),ASC(Y$(I)):GET #6,A:C$(I,I)=CHR$(A)
1004 POSITION ASC(X$(I)),ASC(Y$(I)):? #6;CHR$(13):SOUND 0,7-I,8,8:IF A=129 THEN GOTO 1050
1005 GOTO 1001
1010 I=I-1:IF I=0 THEN 1020
1012 POSITION ASC(X$(I)),ASC(Y$(I)):? #6;C$(I,I):SOUND 0,7-I,8,8:GOTO 1010
1020 IF BURP=1 THEN GOSUB 600:BURP=0
1022 SOUND 0,0,0,0:RETURN
1049 REM GOT A BUG
1050 F(G)=0
1060 SCORE=SCORE+10*(7-MAXWAIT):POKE 656,0:POKE 657,8:? SCORE;"  ":NUMBUG=NUMBUG-1
1070 IF SCORE>BONUS THEN MAXWAIT=MAXWAIT-1:MAXBUG=MAXBUG-5:BONUS=BONUS+100*(7-MAXWAIT):BURP=1
1072 IF MAXBUG<5 THEN MAXBUG=5:MAXWAIT=1
1080 POKE 656,0:POKE 657,3:? 7-MAXWAIT
1090 C$(I,I)=" ":I=I+1:GOTO 1010
1999 REM PRINT FROG SUBROUTINE
2000 POSITION 6,6:? #6;"+8- -+8":POSITION 6,7:? #6;"+8---+8":POSITION 6,8:? #6;"+------8"
2010 POSITION 6,9:? #6;"--8 +--":POSITION 5,10:? #6;"+-+---8-8"
2020 POSITION 5,11:? #6;"---------":RETURN :REM INVERSE CHAR. IN THIS LINE
2999 REM CHANGE CHAR. SET SUBR.
3000 DIM ZZ$(32):RESTORE 3010:FOR I=1 TO 32:READ A:ZZ$(I)=CHR$(A):NEXT I
3010 DATA 104,104,133,204,104,133,203,104,133,206,104,133,205,162,4,160,0
3020 DATA 177,203,145,205,136,208,249,230,204,230,206,202,208,240,96
3030 POKE 106,PEEK(106)-5:GRAPHICS 0:START=(PEEK(106)+1)*256:POKE 756,START/256:POKE 752,1:? "IN
ITIALIZING ...."
3040 A=USR(ADR(ZZ$),57344,START):RESTORE 3100:FOR I=START+8 TO START+119:READ A:POKE I,A:NEXT I
3050 RETURN
3100 DATA 0,34,85,62,54,85,34,0,0,102,102,102,0,0,0,0,255,241,241,241,129,129,255,255
3110 DATA 255,189,189,189,129,129,255,255,255,143,143,143,129,129,255,255,255,129,143,143,143,12
9,255,255
3120 DATA 255,129,129,143,143,143,255,255,255,129,241,241,241,129,255,255,255,129,129,241,241,24
1,255,255
3130 DATA 240,240,240,240,240,240,240,240,15,15,15,15,15,15,15,15,0,0,0,0,0,24,24,48
3140 DATA 255,255,255,255,255,255,255,255,255,145,145,255,145,145,255,255
```

A+F SOFTWARE A+F

PAINTER – BBC SPECTRUM, ATOM
Completely machine coded Arcade game. 6 levels. 16 different screens. Runs in colour on the Atom without F.P. BBC cassette £8. Disk £11.50. Atom cassette £6.90. Spectrum cassette £5.75.

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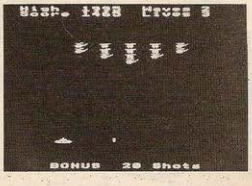
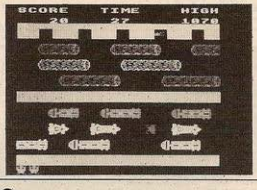
BBC Cass. £8.00 Disc £11.50.
Spectrum cassette £5.75.





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Listing 1.

```
 5*KEY 10 "?&18=&18|MOLD|M"
 10 LX=&D00
 20 ohr%=&C00:oswrch=&FFEE
 30 DIM T% 600
 40 TX=&D21
 50 DIM D% 15
 60 DX=LX+1:dX=LX+9
 70 DIM M% 15
 80 MX=LX+17
 90 FOR OX=MX TO MX+12 STEP 4
 100 READ KX:!OX=KX:NEXT
 110 FOR opt = 0 TO 3 STEP 2
 120 PX=TX
 130OPT opt
 140.9char STX &70
 150STY &71        \ store X%,Y%
 160LDA &601
 170STA &7E        \ find string address
 180LDA &602
 190STA &7F
 200LDY #0
 210LDA (&7E),Y
 220STA &72        \ store lsb string add
 230INY
 240LDA (&7E),Y
 250STA &73        \ store msb string add
 260INY
 270INY
 280LDA (&7E),Y
 290STA &74        \ store string len
 300LDA #0
 310STA &75        \ zero counter
 315 \ ****** main control routine *******
 320 .nchr JSR rot
 330 JSR OPUT
 340 INC &75
 350 LDA &75
 360 CMP &74    \ compare length re counter
 370 BCC nchr
 380 RTS    \ end of control loop
 1000 \***** START OF ROTATE ROUTINE *****
 1010.rot LDA #0
 1020STA &7D
 1030LDY &75
 1040LDA (&72),Y     \ get chr from string
 1050CMP #127        \ system or user-defined ?
 1060BCC R1
 1070SBC #224
 1080STA &77         \ ordinal No user-defined
 1090LDA #&0C        \ base of user characters
 1100JMP R2
 1110.R1 SBC #31
 1120STA &77         \ ordinal No user-defined
 1130LDA #&C0        \ base of system characters
 1140.R2 STA &7E     \ store base value
 1150LDA #0          \ multiply ordinal number by eight
 1160STA &7C
 1170LDA &77
 1180LDX #2
 1190CLC
 1200.R3 ROL A
 1210ROL &7C
 1220DEX
 1230BPL R3
 1240CLC
 1250ADC &7D         \ add to base value and store
 1260STA &7D         \ the result in &7D/E
 1270LDA &7C
 1280ADC &7E
 1290STA &7E
 1300LDY #7          \ move the character definition
 1310.R4 LDA (&7D),Y   \ into D%
 1320STA D%,Y
 1330DEY
 1340BPL R4
 1350\***** START OF TURN ROUTINE *****
 1360LDA &70      \ original value of X%
 1370STA &7F
 1380BEQ R8       \ no turn required
 1390.R5 LDY #7   \ No of bytes in def
 1400.R6 LDA D%,Y \ get a byte
```

(listing continued on next page)

ALL BBC CHARACTERS GREAT AND SMALL

Mix double-height, normal and double-width text on the screen at the same time. Fintan Culwin shows you how to do it.

GROUPS OF PEOPLE and the young are supposed to find the 20-column modes of the BBC Micro easier to read. Personally I have never found this true. The double-width characters are too far removed from any other form of printed character to be easily recognisable; double-width and double-height characters would be much more effective. The double-height characters of mode 7 can be used very effectively to title and highlight parts of the text without this disadvantage, however no other graphics mode allows different-sized characters to be mixed on the screen. Another shortcoming of the text capability of the high-resolution modes is the inability to produce text in any other orientation than the conventional left-right direction. It is useful, for example, to label graphs by plotting text from the bottom to the top of the screen, or with games to plot a user-defined character in more than one orientation.

Having grown used to having these facilities available on other machines, I produced the machine-code program shown in listing 1 to make possible a much more flexible use of text in BBC high-resolution graphics modes. Specifically it will plot a string on to the screen in any one of four orientations in any one of four character sizes.

The four possible sizes are normal, double-width, double-height, and double-width and height. These sizes are related to the normal character sizes for the graphics mode you are currently using. The double-width and double-height options refer to the screen and not to the character — take a deep breath and think about it.

Listing 2.

```
 232 DEF PROCGCHAR(X%,Y%,string$)
 1005 LOCAL L%,T%
 1010 IF X%<0 OR X%>3 THEN PROCERROR
 1020 IF Y%<0 OR Y%>3 THEN PROCERROR
 1030 FOR L%=1 TO LEN(string$)
 1040 T%=ASC(MID$(string$,L%,1))
 1050 IF T%<32 OR T%>126 AND T%<125
      THEN PROCERROR
 1060 NEXT L%
 1070 CALL &0D21,string$
 1080 ENDPROC
 1100 DEFPROCERROR
 1110 PRINT"Incorrect use of 9char
      function"
 1120 PRINT' "Called with "',"X%",
      X%',"Y%",Y%',"  ",string$
 1130 END
```

Listing 3.

```
 135 .9char LDA #0
 136 STA &76
 137 ROL &76    \ STORE C%
 140 STX &70
>
 1510 .R8 LDA &76  \ normal or inverse?
 1520 BEQ R12      \normal !
 1530 LDY #7       \ start of invert
 1540 .R11 LDA D%,Y
 1550 EOR #&FF     \ invert here
 1560 STA D%,Y
 1570 DEY
 1580 BPL R11      \ end of invert
 1590 .R12 RTS     \** END OF ROT**
```

The size is selected by the value of Y% when the routine is called. The values are 0 for normal, 1 for double-width, 2 for double-height and 3 for double-width/height. These are controlled in a similar manner by the value of X%. The routine itself does not perform any error-checking on the values of X% and Y%. Values of Y% in excess of three will cause a default of double-width/height, but values of X% higher than three will cause disastrous results.

The string to be plotted is passed to the routine via the Call command. The first argument to the Call command is the entry point to the routine. In this case, the absolute value is &0D21 labelled by the variable GChar. The second argument to the Call is the variable name of the string, and not the string itself. The characters within the string can include any printable character. A random noise pattern will result if any control codes are passed in the string.

It is possible to perform error checking on the string and on the control variables from within the routine, but in the interests of keeping the code as short as possible I have omitted them from the version presented here. Instead, I have included listing 2 which is a procedure to check for these errors and halt

(continued on next page)

(continued from previous page)

program execution if such an error occurs. It uses X% and Y% as formal parameters to the procedure so it is safe to use these within the main body of the program without any confusion.

The routine was written on a machine fitted with operating system 0.1 EPROM. One of the jobs the routine has to do is to calculate the position in memory where the character definitions have been stored. The new user guide describes an Osword call implemented from version 1.0 onwards which will do this. If you have OS 1.0 fitted, the code given in listing 3 will ensure that the whole program runs smoothly.

Routine protection

The routine occupies less than 200 bytes hex and can thus fit into less than two pages of memory. Page &0D is reserved for user-supplied resident routines. If this and the following page are used, then the routine will only occupy one page of what is usually user memory. The routine has to be protected against the Resetting of Page by the operating system when the break key is pressed. This is done by the Key 10 definition in line 5. Before a final version of the routine is loaded or run this page must be reserved for it by resetting Page to &1000.

Once a working copy of the routine is successfully installed in the memory at this position a direct copy of the code can be made by Saving this section of memory. To do this use the *Save command.

For example

*SAVE "gchar" 0D00 0FFF

The code can be directly loaded back into memory using the *Load command

*LOAD "gchar"

Both of these operations are best done with full CFS information displayed. To do this use the command

*OPT 1,2

Remember to reset Page before attempting any Basic and to protect the Reset as described.

A note to model A owners or even extravagant users of model Bs. Up to two extra pages of memory can be obtained by resetting Page downwards. Program memory usually starts at &0E00. The page below this is reserved for user-supplied routines. If these are not being supplied then Page can be reset to &0D00 to allow Basic to use it. Page &0C is where the user-defined character information is stored. If user-defined characters are not being used within the program then this also can be used for program memory. The reset has to be protected against the Break key as described.

Most of the routine is explained in outline by the comment entries in the listing. It should be possible, if you are familiar with 6502 machine code, to reduce or enlarge the number of options fairly easily. The only non-standard part of the code is the method of storing the cursor movement information. The information for moving the cursor is stored in the 16-byte data block labelled by M%.

Each byte of data holds the information for horizontal and vertical movement of the cursor. The byte is split into two nybbles — four bits — each nybble holds a three-bit number and the sign. The first — left-most — nybble holds the up-down information in the order high bit, middle bit, low bit and sign.

Where sign is 0 for upward movement and 1 for downward movement. The second nybble holds information for left/right movement in a similar way but the order of the bits is reversed. Sign 0 indicates rightward movement and sign 1 leftward. This allows the maximum movement between characters of seven-character cells in any direction. The information is extracted from the data block decoded and implemented in the cursor subroutine.

If you are not conversant with BBC assembler the program can be copied directly into your machine.

Type and test

To facilitate typing and testing the program the actual location of the code can initially be left to the machine operating system. This will allow the routine to be entered and tested without bothering to reset Page, and possibly overwrite the program if any problems arise. To do this omit lines 5, 40, 60 and 80 until the routine has been fully tested. Then Load the program from &1000 upwards before re-entering the missing lines which locate it in pages &0D and &0E.

The final point to note is that the information is actually sent to the screen by continually redefining character 224 which is consequently unavailable for other uses within the user program. This restriction is accounted for within the ProcGchar procedure listing given.

(listing continued from previous page)

```
1410LDX #7          \ No of bits
1420.R7 ROL A       \ Push off a bit
1430ROR d%,X        \ catch within d%
1440DEX
1450BPL R7          \ any more bits ?
1460DEY
1470BPL R6
1480JSR dtoD        \ move turned character back to D%
1490DEC &7F
1500BNE R5          \ any more turns ?
1510.R8 RTS  \** END OF ROT **
2000 \***** START OF OUTPUT ROUTINE ****
2010.OPUT LDA &71   \ original value of Y%
2020CMP #0
2030BEQ normal      \ Y%=0
2040CMP #1
2050BEQ dwid        \ Y%=1
2060CMP #2
2070BEQ dhei        \ Y%=2
2080JMP dwihi       \ Y%>=3
2090RTS   \** END OF OPUT CONTROL **
2095 \***** START OF NORMAL *****
2100.normal JSR DtoO  \ normal size
2110LDA #224        \ move D% to O%
2120JSR oswerch     \ send to screen
2130JSR curs        \ move cursor
2140RTS  \ ** END OF NORMAL **
2300 \***** START OF DOUBLE WIDTH *****
2310.dwid JSR DtoO     \ moves charcter definition
2320JSR wsPlit         \ to O% then sPlits into D%&d%
2330JSR DtoO
2340LDA #224
2350JSR oswerch        \ send first Part to screen
2360JSR dtoO
2370JSR DtoO
2380LDA #224
2390JSR oswerch        \ send second Part to Printer
2400JSR curs           \ move cursor
2410RTS \** END OF DWID **
3000 \***** START OF DOUBLE HEIGHT ****
3010.dhei JSR hsPli  \ hsPli adresses screen directly
3020JSR curs         \ move cursor
3030RTS   \ ** END OF DOUBLE HEIGHT **
3100 \***** START OF DOUBLE WIDTH/HEIGHT *****
3110.dwihi JSR DtoO   \ transfer definition to ochr
3120JSR wsPlit        \ sPlit horizontaly
3130JSR hsPli         \ send lhs to screen
3140LDA #10
3150JSR oswerch       \ move cursor
3160JSR dtoD          \ transfer rhs info
3170JSR hsPli         \ send rhs to screen
3180JSR curs          \ move cursor
3190RTS   \ ** END OF DWIHI **
4000 \ ***** START OF HEIGHT SPLIT *****
4010.hsPli  LDA #1       \ heightsplit
4020STA &7F              \ set up counter
4030LDY #0
4040.h1 LDA D%,Y
4050PHA
4060INY
4070CPY #8                \ Push eight bits of definition
4080BMI h1                \ onto Processor stack
4090.h2 LDY #7
4100.h3 PLA               \ take four bits off
4110STA ohr%,Y            \ stack and put into ochr
4120DEY
4130STA ohr%,Y            \ twice
4140DEY
4150BPL h3                \ four bits done ?
4160LDA #224
4170JSR oswerch           \ send to screen
4180LDA &7F
4190BEQ h4                \ branch if all done
4200LDA #8
4210JSR oswerch
4220 LDA #11
4230JSR oswerch           \ else move cursor
4240DEC &7F               \ and decrease counter
4250JMP h2
4260.h4 RTS \** END OF HSPLIT **
4500 \***** START OF WORD SPLIT *****
4510.wsPlit        \ splits character
4520LDX #1         \ in ochr into
4530STX &7F        \ D% and d%
4540.s1 LDY #3     \ no of bits to move
4550.s2 LDX #7     \ no of bytes to
4560.s3 LSR ohr%,X \ Push off a bit
4570BCC s4         \ jump if not set
4580ROR D%,X
4590SEC
4600ROR D%,X       \ Put two set bits into D%
4610JMP s5
4620.s4 ROR D%,X
4630CLC
4640ROR D%,X       \ Put two blanks into D%
4650.s5 DEX        \ any more bytes
4660BPL s3
4670DEY            \ any more bits
4680BPL s2
4690LDA &7F
```

```
4700LSR A
4710BCC s6          \ branch if all done
4720JSR Dtod        \ else send this half to dX
4730DEC &7F         \ and decrease the counter
4740JMP s1          \ and do the othert half
4750.s6 RTS ** END OF WSPLIT **
5000 \***** START OF CURSOR CONTROL *****
5010.curs LDA #0
5020STA &7D
5030STA &7E
5040LDA &71     \ Get original value of YX
5050CLC
5060ROL A
5070CLC
5080ROL A       \ multiply it by eight
5090ADC &70     \ add result to original value of XX
5100TAY
5110LDA MX,Y    \ and use as an offset to the data table
5120STA &7F
5130LDX #4          \ store mxblle controlin9 left/rig9ht
5140 .C1 ROR A
5150ROL &7D
5160DEX
5170BNE C1
5180LDA &7F
5190LDX #4          \ store mxbble controlin9 uP/down
5200.C2 ROL A
5210ROL &7E
5220DEX
5230BNE C2
5240LSR &7D     \ decode left/right
5250BCS m1      \ character data
5260LDA #9      \ Prime for right
5270JMP m2
5280.m1 LDA #8      \ Prime for left
5290.m2 JSR cmv     \ move left/right
5300LDA &7E
5310LSR A
5320STA &7D         \ decode and transfer uP/right
5330BCS m3
5340LDA #11         \ Prime for uP
5350JMP m4
5360.m3 LDA #10     \ Prime for down
5370.m4 JSR cmv     \ move uP/down
5380RTS \ ** END OF CURS **
5390 \***** START OF CURSOR MOVER *****
5400.cmv LDX &7D    \ No of moves
5410.c1 BEQ c2      \ branch if all done
5420JSR oswrch      \ move cursor
5430DEX             \ decrease counter
5440JMP c1
5450.c2 RTS \ ** END OF CMV **
5999 \***** UTILITY ROUTINES *****
6000 .DtoO LDY #7       \ copies D% to ochr%
6010 .z1 LDA D%,Y
6020 STA ohr%,Y
6030 DEY
6040 BPL z1
6050 RTS \ ** END OF D to O **
6060 .dtoD LDY #7       \ copies d% to D%
6070 .z2 LDA d%,Y
6080 STA D%,Y
6090 DEY
6100 BPL z2
6110 RTS \ END OF d to D **
6120 .Dtod LDY #7       \ copies D% to d%
6130 .z3 LDA D%,Y
6140 STA d%,Y
6150 DEY
6160 BPL z3
6170 RTS \ END OF D to d
6180]
6190 NEXT
7000 MODE 4
7010VDU 23;8202;0;0;0
7020VDU 5
7030 VDU 23,225,24,60,90,126,60,24,60,66
7040a$="Testing": GOSUB 7500
7050a$=STRING$(7,CHR$225):GOSUB 7500:GOTO 7040
7500Y%=0:X%=0:PRINTTAB(16,11);:CALL 9char,a$
7510X%=1:PRINTTAB(15,17);:CALL 9char,a$
7520X%=2:PRINTTAB(22,17);:CALL 9char,a$
7530X%=3:PRINTTAB(23,11);:CALL 9char,a$
7540Y%=1:X%=0:PRINTTAB(12,6);:CALL 9char,a$
7550X%=1:PRINTTAB(12,17);:CALL 9char,a$
7560X%=2:PRINTTAB(25,22);:CALL 9char,a$
7570X%=3:PRINTTAB(25,11);:CALL 9char,a$
7580Y%=2:X%=0:PRINTTAB(16,9);:CALL 9char,a$
7590X%=1:PRINTTAB(10,20);:CALL 9char,a$
7600X%=2:PRINTTAB(22,20);:CALL 9char,a$
7610X%=3:PRINTTAB(20,8);:CALL 9char,a$
7620Y%=3:X%=0:PRINTTAB(12,4);:CALL 9char,a$
7630X%=1:PRINTTAB(7,20);:CALL 9char,a$
7640X%=2:PRINTTAB(25,25);:CALL 9char,a$
7650X%=3:PRINTTAB(30,8);:CALL 9char,a$
7660 B$="Press":X%=0:Y%=3:PRINTTAB(6,30);:CALL 9char,B$
7670  B$="the":Y%=2:PRINTTAB(17,30);:CALL 9char,B$
7680 B$="SPACE":Y%=3:PRINTTAB(21,30);:CALL 9char,B$
7685 B$="BAR":Y%=1:PRINTTAB(32,30);:CALL 9char,B$
7690PRINTTAB(1,1);  REPEAT UNTIL GET=32
7700 RETURN
9000 DATA &3C8A2C00,&3A092A00
9010 DATA &7C3A2C30,&7A392A30
```

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CHARACTER EXERCISES FO YOUR

THE SPEED of Forth and being able to redefine standard graphic characters are features of the Jupiter Ace which make it ideal for improved quality printing — either on screen or on paper — a parallel printer has been promised by Jupiter Cantab.

The *Jupiter Ace Handbook* explains that the character set is contained in RAM addresses 11264 to 12287. These characters can be changed by writing new values into this RAM, but cannot be read back again. The initial character set is created from the ROM when the computer is switched on. The raw data to generate the characters is contained in ROM bytes 7547 to 8187 which consist of an abbreviated set of ASCII characters 32 to 127. If you want to see this data, define the words DD and Change01 as follows:

```
: DD
  DUP 16 + DUP ROT
  DO
    I C@ 256 + 2 BASE C!
    . DECIMAL 32 EMIT I . CR
  LOOP ;
: CHANGE01
  11264 48 8 * + 8 0
  DO
    DUP 128 SWAP C! 8 +
    DUP 255 SWAP C! 7 -
  LOOP
  1- 255 SWAP C! ;
```

Now enter

```
CHANGE01 INVIS CLS 7547 DD
```

and enter further DD as required. The program displays the ROM data in succession — with an additional character on the left-hand side — and the byte number at the right. The word Change01 has turned the character 0 into a black square and the character 1 into a white square, so that the ASCII characters are readily discernible.

If you look carefully at this section of ROM, you will see that the ASCII characters 32 to 62 copy seven bytes at a time. The top line of each character is a zero byte. ASCII characters 63 to 94 only use six bytes each with zero top and bottom, while 95 to 126 use seven as before. Finally character 127 uses all eight bytes.

When you have finished looking at the ROM, enter Abort to clear the data stack.

The ROM data provides a very simple means of returning any character set you may have devised back into the original form. For example, we do not want 0s and 1s to look like black and white squares for the rest of their lives. The word Reset emulates the action of the computer when it is first switched on, restoring to original any altered characters between 32 and 127.

Two utility words are needed — ROW which enters a single byte where ordered, and Block, which copies a prescribed block of data from the ROM.

```
: ROW
  OVER C! 1+ ;

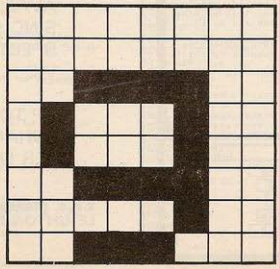
: BLOCK
  0 DO
    OVER C@ ROW SWAP
    1+ SWAP
  LOOP ;

: RESET
  7547 11520 31 0
  DO 0 ROW 7 BLOCK
  LOOP 32 0
  DO 0 ROW 6 BLOCK 0 ROW
  LOOP 32 0
  DO 0 ROW 7 BLOCK
  LOOP 8 BLOCK ABORT ;
```

Now Redefine DD and Change 01. This removes them from the dictionary and leaves just Row, Block and Reset. Define another word Test to display all the characters on the screen:

```
: TEST
  127 32
  DO I EMIT
  LOOP 4 1
  DO I EMIT
  LOOP ;
```

BEFORE



You will notice that three graphic characters appear at the end — we will need to look at these later on; they will be changed into something more useful.

Examine the letters critically — several things detract from their appearance: the lines of writing are too close together; some lower case letters seem to be too short, not lining up with the top of the other letters; and the descenders — the tails that are supposed to fall below the line — hardly descend at all.

To overcome crammed writing one simple remedy is to print a blank line between lines of type. At first this might appear to space the lines out too far, but if the blank lines are used to draw better descenders and we increase the size of the capitals, the spacing looks just right.

The word Capital increases the height of ASCII characters 63 to 94 — it simply doubles

R-FORMING
OR
ACE

Roger Liddiard's programs will help convert your deformed characters into true descenders of the Ace

up on the top two lines of the characters:

```
: CAPITAL
 7764 11768 32 0
 DO 2 BLOCK SWAP
   4 + SWAP 6 +
 LOOP DROP DROP ;
```

The offending lower-case letters are stretched in a similar manner to smooth out their tops:

```
: LCASE
 1 1 4 4 4 1 4 1 4 1 4 7977 12048 11 0
 DO 3 PICK BLOCK 3 PICK —
   SWAP ROT - 7 + SWAP 8 +
 LOOP DROP DROP ;
```

Now to put proper tails on your letters. The letters g, j, p, q and y are re-defined and their tails are drawn in graphic characters 1, 2 and 3. Yes, you only need three tails — those of g, j, and y are the same.

The word Descenders makes this transformation — of course the tails are lost until we double space the typing, but you can see them being formed in the last three characters of Test.

```
: DESCENDERS
 4 6 64 64 56 68 11272
 DUP 24 0
 DO 0 ROW
 LOOP DROP 3 0
 DO 2 0
   DO SWAP ROW
   LOOP 6 +
 LOOP DROP
 8141 12237 8085 12173 8078 12165
 8035 12117 8015 12093 5 0
 DO 3 BLOCK DROP DROP
 LOOP ;
```

If your Jupiter Ace has no additional memory, you will soon be running out of space, but do not worry — once the new set of characters has been formed, we can clear the dictionary and start again with some new words. So Save what we have done so far, then enter

```
CAPITAL LCASE DESCENDERS FORGET
RESET
```

which should clear out the dictionary — check it with VList. Now the finale.

Start by entering two utilities:

```
 32 VARIABLE NN
 : PRINT ;
```

Then define the word DType. It is quite long but its effect is dramatic:

```
 : DTYPE
   32 NN ! FIND DUP 6 + SWAP 5 - @ 13 -
   BEGIN
     DUP 32>
       IF
       ELSE DUP NN !
       THEN NN @ 0 >
   WHILE
     BEGIN
       INKEY DUP 80 =
       IF PRINT
       THEN
     UNTIL NN @ - SWAP DUP NN @ +
     SWAP NN @
     TYPE SWAP 32 NN @ - SPACES 32 0
     DO 113 113 113 112 112 121 106 103
       0 15388 @ 32 - C@ 8 0
       DO DUP 4 ROLL = ROT + SWAP
       LOOP DROP DUP
         IF
         ELSE DROP 32
         THEN EMIT
       LOOP
       REPEAT DROP DROP ;
```

DType is used in conjunction with a word containing text. It starts on a new line so the text is best arranged in complete paragraphs. The first 32 letters are typed out, followed by a line of blanks and descenders. It then waits for you to press any key before repeating the process with the next 32 letters. This control facility is very useful when you need to control the amount of text you wish to display, for example when a printer is used to copy a screenful of text. A dummy word Print has been included — if the letter P is pressed this subroutine is called up — it will be useful in the future. To use DType, define some text such as

```
 : P1 ." abcdefghijklmnop etc. " ;
```

preferably with more than one line of characters. Because DType uses the word Find, and calculates the length of text in P1, another word must appear in the dictionary after P1, otherwise the bytes in P1's header which define its length, will not be complete. So add a dummy word :P2 ; on the end.

Now enter

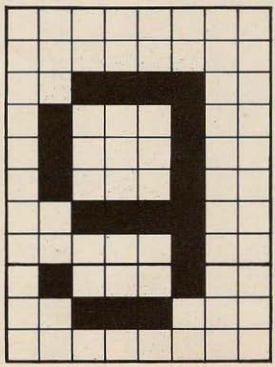
```
INVIS CLS DTYPE P1
```

when the first line is complete, press any key and the next line will appear. The advantages of storing text in colon definitions are that the length of text is not limited to 256 characters and full Edit facilities are available. In addition, memory space is not wasted in defining new words such as String. Successive paragraphs can be displayed by means of

```
DTYPE P1 DTYPE P2 DTYPE P3 etc.
```

and paragraphs can be interspersed with additional blank lines by the use of CR as required. Your text can be Saved on tape in the normal manner. ■

AFTER



THIS PROGRAM will run only on the 1K ZX-81, and so RAM packs must be disconnected before the program is loaded. Before entering the machine code, space must be reserved for it. The easiest way to do this is with Rem statements, so type in lines 1 and 2 as:

```
1 REM 344 zeros
2 REM 167 zeros
```

It is advisable to enter lines 1 and 2 in Fast mode.

When the Rem statements are complete, enter the following hex code loading program.

```
10 LET X = 16514
20 LET A$ = ""
30 IF A$ = "" THEN INPUT A$
40 IF A$ = "S" THEN STOP
50 PRINT AT 0,0;X,A$ ( TO 2 )
60 POKE X, 16*CODE A$ + CODE A$ (2)
   - 476
70 LET X = X + 1
80 LET A$ = A$ ( 3 TO )
90 GOTO 30
```

Run the program, and in response to the input prompt enter the bytes in the column on the left-hand side of the address column — each two characters make one byte. For example, one may enter the first five bytes of the machine code in a block or one byte at a time, thus:

2A3240 NEWLINE 54 NEWLINE 5D NEWLINE

and so on. Do not enter any spaces with the hex codes. Take your time when entering the machine code, as one wrong byte could cause disaster. If at any time you make a mistake, break out by inputting a single S. Then type in line 10 again, but this time with an address you know to have been correctly loaded. Then continue from that address by running the program.

When all of the machine code has been entered, break out by entering a single S, and then type in line three as:

```
3 RAND USR 16530
```

then delete lines 10 to 90.

Now Save the program before running it. After saving the program, type in, as direct commands

```
RAND
```

then

```
RUN
```

If everything is running happily, your jet should be resting on a flat area of landscape ready for take off, a hilly landscape should be moving towards you, and the flak should be moving across the screen. If your aeroplane collides with the hillside it will explode, stopping the program.

Keys 1,2,3,4,5,Q,W,E,R, and T move your plane up, and keys A,S,D,F,G,Z,X,C, and V move it down. Keys 6,7,8,9,0,Y,U,I,O,P drop a bomb from the jet. Shooting a base — represented by an A — earns you 10 points.

If something has gone wrong, turn off the power supply and then reload the program from tape. To debug it, enter the following program:

```
10 FOR F = 16514 TO 17030
20 LET X = PEEK F
30 PRINT CHR$ (INT (X/16) + 28);
   CHR$ (X - INT(X/16) * 16 + 28)
40 NEXT F
```

and run it. The machine code is displayed 22 bytes at a time. After checking each byte for errors, enter:

```
CONT NEWLINE
```

for the next 22. When an incorrect byte is found, correct it by Poking its address with the decimal equivalent of the correct byte — see conversion tables at the back of the ZX-81 manual. When debugging is complete, delete lines 10 to 40. To speed the game up, Poke address 16627 with a number between 1 and 15; to slow the game down, Poke address 16627 with a number between 16 and 255.

16514	2A	16547	10	16580	36	16615	3C	16655	5D	16699	12
16515	32	16548	FD	16581	82	16616	40	16656	23	16700	00
16516	40	16549	3E	16582	2A	16617	11	16657	05	16701	19
16517	54	16550	76	16583	0C	16618	12	16658	12	16702	E5
16518	5D	16551	D7	16584	40	16619	00	16659	7E	16703	CD
16519	29	16552	0D	16585	11	16620	19	16660	FE	16704	82
16520	29	16553	20	16586	07	16621	22	16661	85	16705	40
16521	19	16554	F3	16587	00	16622	3E	16662	28	16706	44
16522	29	16555	0E	16588	19	16623	40	16663	0C	16707	3E
16523	29	16556	02	16589	11	16624	00	16664	FE	16708	01
16524	29	16557	3E	16590	40	16625	01	16665	02	16709	3C
16525	19	16558	09	16591	40	16626	00	16666	20	16710	FE
16526	22	16559	06	16592	06	16627	10	16667	04	16711	05
16527	32	16560	13	16593	06	16628	08	16668	3E	16712	20
16528	40	16561	D7	16594	55	16629	78	16669	85	16713	02
16529	C9	16562	10	16595	91	16630	20	16670	18	16714	3E
16530	3E	16563	FD	16596	14	16631	FE	16671	11	16715	01
16531	1C	16564	3E	16597	08	16632	00	16672	FE	16716	10
16532	06	16565	76	16598	E5	16633	FA	16673	18	16717	F7
16533	06	16566	D7	16599	73	16634	3A	16674	20	16718	47
16534	D7	16567	0D	16600	23	16635	4C	16675	04	16719	C1
16535	10	16568	20	16601	72	16636	40	16676	3E	16720	11
16536	FD	16569	F3	16602	23	16637	3C	16677	00	16721	EC
16537	3E	16570	38	16603	EB	16638	32	16678	18	16722	FF
16538	76	16571	0C	16604	09	16639	4C	16679	09	16723	35
16539	D7	16572	40	16605	C1	16640	40	16680	FE	16724	08
16540	0E	16573	11	16606	10	16641	CB	16681	00	16725	19
16541	09	16574	AA	16607	F2	16642	47	16682	20	16726	10
16542	3E	16575	00	16608	2A	16643	20	16683	05	16727	FB
16543	00	16576	19	16609	0C	16644	77	16684	18	16728	FE
16544	06	16577	36	16610	40	16645	2A	16685	FE	16729	04
16545	18	16578	86	16611	11	16646	0C	16686	02	16730	26
16546	D7	16579	23	16612	AA	16647	40	16687	20	16731	20
				16613	00	16648	11	16688	F3	16732	F5
				16614	19	16649	80	16689	12	16733	E5
						16650	00	16690	23	16734	CD
						16651	19	16691	13	16735	82
						16652	0E	16692	10	16736	40
						16653	03	16693	DD	16737	7C
						16654	54	16694	23	16738	FE
								16695	0D	16739	32
								16696	20	16740	E1
								16697	D4	16741	30
								16698	11	16742	02

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Your terrain-hugging mission to destroy ground targets means weaving a perilous path through the heavy flak in Phillip Tyler's machine-code game.

				16835	3C	16883	2A	16931	B4	16979	CD
				16836	40	16884	3C	16932	2A	16980	82
16743	36	16789	08	16837	FE	16885	40	16933	0C	16981	40
16744	26	16790	18	16838	08	16886	23	16934	40	16982	7C
16745	F1	16791	08	16839	28	16887	18	16935	11	16983	E1
16746	3C	16792	CB	16840	00	16888	3E	16936	BC	16984	FE
16747	47	16793	55	16841	FE	16889	2A	16937	00	16985	28
16748	3E	16794	28	16842	26	16890	3E	16938	19	16986	30
16749	04	16795	04	16843	20	16891	40	16939	22	16987	1C
16750	00	16796	CB	16844	04	16892	06	16940	3E	16988	11
16751	47	16797	5D	16845	FE	16893	00	16941	40	16989	13
16752	FE	16798	28	16846	34	16894	7E	16942	18	16990	00
16753	00	16799	38	16847	20	16895	FE	16943	14	16991	19
16754	28	16800	11	16848	E6	16896	06	16944	78	16992	10
16755	00	16801	EC	16849	19	16897	28	16945	FE	16993	14
16756	11	16802	FF	16850	35	16898	21	16946	00	16994	36
16757	EC	16803	2A	16851	17	16899	FE	16947	20	16995	00
16758	FF	16804	3C	16852	23	16900	26	16948	0A	16996	FE
16759	19	16805	40	16853	36	16901	20	16949	36	16997	B4
16760	36	16806	36	16854	17	16902	17	16950	00	16998	20
16761	00	16807	00	16855	C9	16903	36	16951	11	16999	08
16762	10	16808	23	16856	10	16904	00	16952	15	17000	28
16763	FB	16809	36	16857	06	16905	2A	16953	00	17001	7E
16764	2A	16810	00	16858	76	16906	0C	16954	19	17002	FE
16765	3C	16811	19	16859	08	16907	40	16955	06	17003	76
16766	40	16812	7E	16860	02	16908	11	16956	50	17004	20
16767	23	16813	FE	16861	A9	16909	05	16957	18	17005	FA
16768	7E	16814	00	16862	00	16910	00	16958	BF	17006	18
16769	FE	16815	20	16863	FA	16911	19	16959	36	17007	08
16770	82	16816	11	16864	CD	16912	7E	16960	18	17008	28
16771	25	16817	2B	16865	BB	16913	3C	16961	22	17009	7E
16772	03	16818	7E	16866	02	16914	FE	16962	3E	17010	FE
16773	2B	16819	FE	16867	CB	16915	26	16963	40	17011	76
16774	10	16820	00	16868	65	16916	20	16964	21	17012	28
16775	4A	16821	28	16869	26	16917	05	16965	40	17013	02
16776	CD	16822	05	16870	04	16918	C5	16966	40	17014	34
16777	BB	16823	36	16871	CB	16919	1C	16967	06	17015	36
16778	02	16824	86	16872	64	16920	26	16968	05	17016	00
16779	CB	16825	23	16873	20	16921	18	16969	C5	17017	34
16780	45	16826	36	16874	0E	16922	F5	16970	5E	17018	EB
16781	28	16827	82	16875	2A	16923	77	16971	23	17019	E1
16782	04	16828	2B	16876	0E	16924	18	16972	56	17020	72
16783	CB	16829	22	16877	40	16925	06	16973	E5	17021	2D
16784	4D	16830	3C	16878	7E	16926	FE	16974	EB	17022	73
16785	29	16831	40	16879	FE	16927	34	16975	7E	17023	23
16786	05	16832	18	16880	00	16928	20	16976	FE	17024	23
16787	11	16833	16	16881	20	16929	0E	16977	76	17025	C1
16788	14	16834	2A	16882	06	16930	36	16978	28	17026	10
								16979	10	17029	F1
								16980	E5	17030	40

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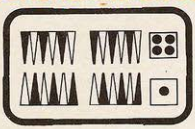

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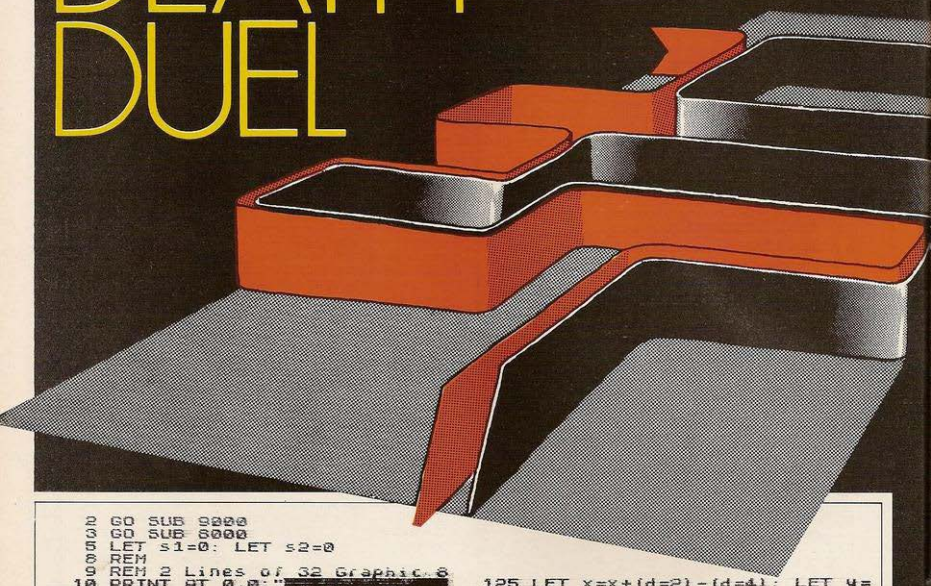

```
  2 GO SUB 9000
  3 GO SUB 8000
  5 LET s1=0: LET s2=0
  8 REM
  9 REM 2 Lines of 32 Graphic B
 10 PRINT AT 0,0;"
 20 PRINT AT 20,0;"
 24 REM
 25 REM 2 Lines of 32 Graphic A
 30 PRINT AT 21,0;"
 40 PRINT AT 1,0;"
 44 REM
 45 REM Graphic B, 30 Graphic b
, Graphic B
 50 FOR f=2 TO 19: PRINT AT f,0
;"
 60 NEXT f
 70 LET x=4: LET y=10
 80 LET a=27: LET b=10
 90 LET d=2: LET c=4
 95 GO TO 100+60*(RND<.5)
110 LET a$=("1" AND IN 63436<>2
55)+("2" AND IN 64510=253)+("3"
AND IN 65022<>255)+("4" AND IN 6
4510=254)
120 IF LEN a$=1 THEN LET d=VAL
a$
125 LET x=x+(d=2)-(d=4): LET y=
y+(d=3)-(d=1)
126 IF SCREEN$ (y,x)<>"" THEN G
O TO 2000
130 PRINT AT y,x; BRIGHT 1; INK
c1;"": REM Graphic B
140 IF SCREEN$ (y+1,x)="" THEN
PRINT AT y+1,x; PAPER c1; INK c1
;"": REM Graphic A
145 BEEP .01,0
160 LET a$=("1" AND IN 61430<>2
55)+("2" AND IN 57342=254)+("3"
AND IN 49150<>255)+("4" AND IN 5
7342=253)
170 IF LEN a$=1 THEN LET c=VAL
a$
175 LET a=a+(c=2)-(c=4): LET b=
b+(c=3)-(c=1)
176 IF SCREEN$ (b,a)<>"" THEN G
O TO 1000
180 PRINT AT b,a; BRIGHT 1; INK
c2;"": REM Graphic B
190 IF SCREEN$ (b+1,a)="" THEN
PRINT AT b+1,a; PAPER c2; INK c2
;"": REM Graphic A
195 BEEP .01,10
200 GO TO 100
```

GAMES

Force your opponent into a corner — that is your goal in this interactive game by Andrew Foord for the 16K ZX Spectrum. Two people can play simultaneously using the keyboard — instructions are shown in the program. The players shoot along the grid leaving a trail of deadly orgone energy in their wakes. This manifests itself on the screen as a wall. To survive you must force your antagonist to career helplessly into either your wake or his own: both will prove equally fatal. The program gives a view of the action — looking from an angle of 45° — by using Bright to make the top of the trail brighter than the front. The player to win is the first to achieve a score of 10. Different trace elements can be injected into the energy-conversion cycle of your overlander to alter the colour of the exhausted field of primary energy you leave in your wake. You can have any colour you want as long as it is not black. To make the game really confusing the two players can even be the same colour.

```
1000 PRINT AT b,a; FLASH 1;" "
1010 LET s1=s1+1
1020 GO TO 3000
2000 PRINT AT y,x; FLASH 1;" "
2010 LET s2=s2+1
3000 FOR f=30 TO 60: BEEP .001,f
: NEXT f
3010 PRINT INVERSE 1;AT 9,11;"PL
ayer 1:";s1
3020 PRINT INVERSE 1;AT 11,11;"P
Layer 2:";s2
3030 FOR f=60 TO 30 STEP -1: BEE
P .001,f: NEXT f
3035 IF s1>9 OR s2>9 THEN GO TO
4000
3040 IF INKEY$<>"" THEN GO TO 30
40
3050 PRINT AT 20,3; INVERSE 1;"P
RESS ANY KEY TO CONTINUE"
3060 IF INKEY$<>"" THEN GO TO 10
3070 GO TO 3060
4000 PRINT FLASH 1;AT 13,10;"PLA
YER ";(s2=10)+1;" WINS"
4010 INPUT "Another go? "; LINE
a$
4020 IF a$="" THEN GO TO 4010
4030 IF a$(1)<>"n" THEN RUN
4040 STOP
8000 BORDER 0: PAPER 0: INK 7: C
LS
8010 PRINT "This is:"
8020 PRINT TAB 13;"CHASER"'"TAB
9;"© ANDREW FOORD"
8030 PRINT '"The object of CHASE
R is to forcethe other player in
to a wall."
8040 PRINT '" Each player has a
chaser which leaves a trail, the
 chasers can not stop until one
is destroyed."
8050 PRINT 'TAB 12;"CONTROLS"
8051 REM ^-Graphic C; v-Graphic
D
8055 PRINT 'TAB 14;"^ < > v"
8060 PRINT '"Player 1:      2 0 W
 A"
8070 PRINT '"Player 2:      0 0 P
 L"
8080 PRINT 'TAB 14;"^ < > v"
8100 INPUT "Players 1 colour? (1
 TO 7) ";c1
8110 IF c1<1 OR c1>7 THEN GO TO
8100
8120 INPUT "Players 2 colour? (1
 TO 7) ";c2
8130 IF c2<1 OR c2>7 THEN GO TO
8120
8140 RETURN
9000 FOR f=0 TO 7 STEP 2: POKE U
SR "a"+f,170: POKE USR "a"+f+1,8
5: NEXT f
9010 FOR f=0 TO 6: POKE USR "b"+
f,128: NEXT f: POKE USR "b"+7,25
5
9020 RESTORE : FOR f=0 TO 7: REA
D a: POKE USR "c"+f,a: POKE USR
"d"+7-f,a: NEXT f
9030 DATA 0,0,8,20,34,0,0,0
9040 RETURN
```

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A VARIABLE is a named memory area inside the Vic which can store varying data. This data can be in the form of numbers or characters. If you can remember algebra at school it typically looked like

x + 2 = y

where x and y are variables. Obviously the value of y will vary as the value of x varies. There are two types of numeric variables used by the Vic — integer and floating point, which is sometimes called real.

Integers are whole numbers with no decimal point and the Vic can only deal with them in the range −32768 to +32767. The Vic will assume that numbers are positive unless you tell it otherwise. Examples of integers are:

1, 100, -32000, 999

Floating-point numbers can have a decimal point and cover a much wider range than integers. Floating-point numbers can also be expressed as a mantissa with an exponent.

VIC-20

Savour Clive Finnis' recipe for slimmer and faster programming with this first course in Vic variables.

VARIABLES: FIRST COURSE ON A PLATE

Simply, this means that the number 1234.5678 can be expressed as a mantissa of 1.2345678 and an exponent of 3, where the exponent means "times 10 to the power of 3", or in this case 1,000. This would be entered into the Vic as:

1.2345678E3

This might seem an unnecessary complication but in fact it makes the entry of very large and very small numbers easier.

For example the number 1,000,000,000.0 in mantissa and exponent form is 1E9 and the number .0000123 will be 1.23E−5.

A negative exponent can be thought of as "move the decimal point to the right", whereas a positive exponent means "move the decimal point to the left". On these two examples we moved the decimal point nine places to the left and ended up with an exponent E9, and in the second case we moved it five places to the right and had an exponent of E−5.

The range covered by the Vic is from ±1.70141183E+38 to ±1.93873588E−39, and the Vic works to nine digits of accuracy. Try some numbers outside this range and see what the Vic makes of them.

But how does the Vic expect you to define variables? What is the syntax for describing a variable? The computer only acts on one, two or three significant characters of the variable name — although variables can be much longer. The first character must be alphabetical. The simplest variable names will be just one alphabetical character — for example, A

In reality the Vic sees this as two characters, one alphabetical, the other a "nothing" character, that is ASCII 0 or null. Try the following:

```
PRINT CHR$(65)
```

You get the letter A — correct? Now try

```
PRINT CHR$(65)CHR$(66)
```

You get AB. Let us, introduce the ASCII 0 or null character in the middle to see what it does. Type

```
PRINT CHR$(65)CHR$(0)CHR$(66)
```

The printout reads AB again — in other words the ASCII null is completely ignored. So when we define our variable names as A, I or X the Vic stores A0, I0, X0.

If you decide to use a second character this can be alphabetical or numeric — that is A through to Z or 0 through to 9, so that AA, A9, XA, X1 are all valid names.

Our third significant character can only be $ or %. These characters define the type of variable that the one or two preceding significant characters represent.

Any variable followed by the % sign means that this is an integer variable. Any variable followed by the $ sign is defined as a string variable. Any variable not followed by % or $ is by default a real variable. Examples of valid variable names are

A	AA	A1	Z9	for real
1A%	AA%	A1%	Z9%	for integer
A$	AA$	A1$	Z9$	for string

Note that you can use, say, A, A% and A$ in one program and the Vic will quite happily differentiate between them — it sees them as three quite separate variables.

Where possible try to pick variable names which mean something to you and relative to the job that they are performing. There are traps for the unwary, through. Say you are using the variable CO. There will be a hidden syntax error in the following apparently good line:

```
FORI=100TOCOSTEP-1
```

The problem? Vic sees the CO of the variable and the S of Step as Cos which is of course a Basic function.

The cure? Put a space between CO and S or find another variable name. What is wrong with C on its own? It will save you two bytes in this instance alone.

In some cases it might be more convenient to use whole words as variable names instead of just one or two characters. For example, if you are writing a program to help sort out your home finances, variables such as Interest, Balance, Debit mean far more when working through your listing than, say, In, Ba and De.

You do not often get something for nothing though and this is no exception. You gain in program clarity — you lose in using more memory to do the same job. Every time your program uses, say, the variable name Interest, it needs eight bytes of memory to store it — one byte for every character. So the difference between using In and Interest is six bytes for each time it is used.

Integer variables are quite literally a waste of time and effort. As you will see later all numeric variables — forget about strings for the moment — are stored as floating-point numbers. Thus when we ask the Vic to perform integer arithmetic as follows:

X% = Y% + Z%

it first takes the floating-point contents of Y% and converts them to integer, then it takes the floating-point contents of Z% and converts them to integer, adds these two integers, then converts from integer to floating point and stores the contents in X%. Not only are you wasting time while the processor performs unnecessary tasks, but the % character uses up one extra byte of memory every time it occurs in the program. Tails you lose, heads you cannot win.

This does not apply to integer arrays. Significant memory saving can be achieved by defining an array as an integer instead of real.

We saw earlier that you cannot use Basic

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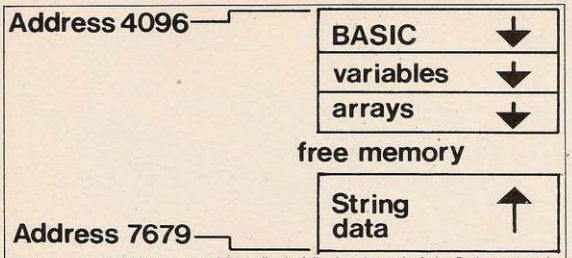


Memory map. Variables are stored immediately following the end of the Basic program in memory, and they are immediately followed by the arrays.

(continued from previous page).

command words or functions as variable names — for example Cos, Sin, New, Print would all be thrown out as syntax errors if you tried to use them as variable names. There are three other reserved words which you cannot use as general-purpose variable names because they are already used by the Vic for specific variables.

ST — short for Status — is used to monitor input-output functions to the screen, cassette, keyboard or serial bus.

TI is used for the real-time clock. This is updated every 0.016 seconds by an interrupt routine.

TI$ is a string variable of six characters length and it will return a real time in the format HHMMSS. It may be initialised — set to zero — easily by TI$="000000".

So now you know something about real and integer variables, but what is the string variable that keeps popping up?

String variables are used to store not numeric information, like real and integer numbers, but any of the 256 ASCII characters available on the Vic. Thus whereas the variable A may contain 1.2345, the variable A$ may contain the word computer. String variables are written to — filled up — in the following manner:

```
A$="COMPUTER"
```

The contents must be framed by the quotation marks Shift and 2 on your keyboard.

String variables are not restricted to storing the letters A through to Z, but can store Vic graphics and control characters as well. For example try the following routine:-

```
10 LET A$="(clear screen)"
20 PRINT A$
```

where (clear screen) is the Shift and Clear Home.

If we Run this routine the screen will clear just as if we had typed

```
PRINT"(clear screen)"
```

Note that the Let in line 10 is optional in Vic Basic. Line 10 could have been written as

```
10A$="(clear screen)"
```

String variables can be up to 255 characters long. This, at first, seems rather difficult to achieve as the maximum number of characters that the Vic will accept for one line of Basic is 88, and this must include the line number itself. We can achieve long string variables — if we really want to — by the process of concatenation of variables. This is really just a complicated way of saying adding together of string variables. For example, the program

```
10 A$="YOUR"
20 B$="COMPUTER"
30 C$=A$+B$
40 PRINTC$
```

produces the result

```
YOURCOMPUTER
```

C$ has effectively taken the contents of A$ (Your) and has joined on the contents of B$ (Computer) to form the longer string.

Using the CHR$ command other characters may be added to the string. For example to get a slightly better format to the result we can amend line 30 to read:

```
30 C$=A$+CHR$(32)+B$
```

which will give us

```
YOUR COMPUTER
```

Character 32 is "space" in the Vic. Another way of achieving the same result here would be to use the construction

```
30 C$=A$+" "+B$
```

Try different combinations yourself. Use the cursor keys and colour characters inside string variables and see what results you get. Try to make a string variable 255 characters long by using concatenation and discover the error message that the Vic will print if you exceed this number.

It is also possible to perform comparisons between string variables by using the following format

```
IF A$=B$ THEN etc.
```

Of course when it comes to operating on variables there are far more operators available for the numeric variables. One word of warning, though: if you want, say, the square of variable A, it might be tempting to use exponentiation of the form

```
B=A↑2
```

However, whereas this will give you the correct result, it is a very slow operation in Basic and you would be better advised to use the less impressive but faster contruct

```
B=A * A
```

So now we have a grasp of the different types of Vic variable and how to use them. But how does the Vic store these variables? To answer that we must first look at the memory map.

In an unexpanded Vic, user memory starts at address 4096 and finishes at address 7679. Addresses 7680 to 8191 are the screen area and thus the total RAM available is 4K of which 0.5K is for the screen leaving the infamous 3.5K for you. To be fair, the reason why RAM is limited on the Vic is because RAM chips were expensive when Commodore designed the Vic a few years ago. The cost of the 4K chips used in the Vic was probably more than 64K chips cost today because of phenomenal advances in RAM technology.

Anyway, back to memory maps. Variables are stored immediately following the end of the Basic program in memory, and they are immediately followed by the arrays. This variable storage area stores both the names and contents of numeric variables, but stores the name only of string variables along with an address of where the actual contents of that variable can be found. The contents or string data are stored downwards from address 7679, that is, top of memory. Thus free memory is actually the gap between string data moving downwards from top of memory and the end of arrays moving upwards.

As the boundaries between these different areas will move as the Basic program is edited, or string variables are changed, or whatever, the Vic must keep a careful note of where these boundaries are. The addresses of these boundaries are stored in specific memory locations in standard low-byte/high-byte order. I know some beginners get confused by these terms: put simply, the Vic can only store eight bits of information in each memory address because it is an eight-bit machine. Eight bits give you a total range of from 0 to 255 only, but the Vic can address a total of 65,535 addresses. Thus to get this range it is generally necessary to use two bytes for each address stored as low byte that is, least significant and high byte — the most significant. The actual address is low byte +256 (high byte). If you work out 255+256×255 you get 65,535 — thus we can address the whole Vic range using this format.

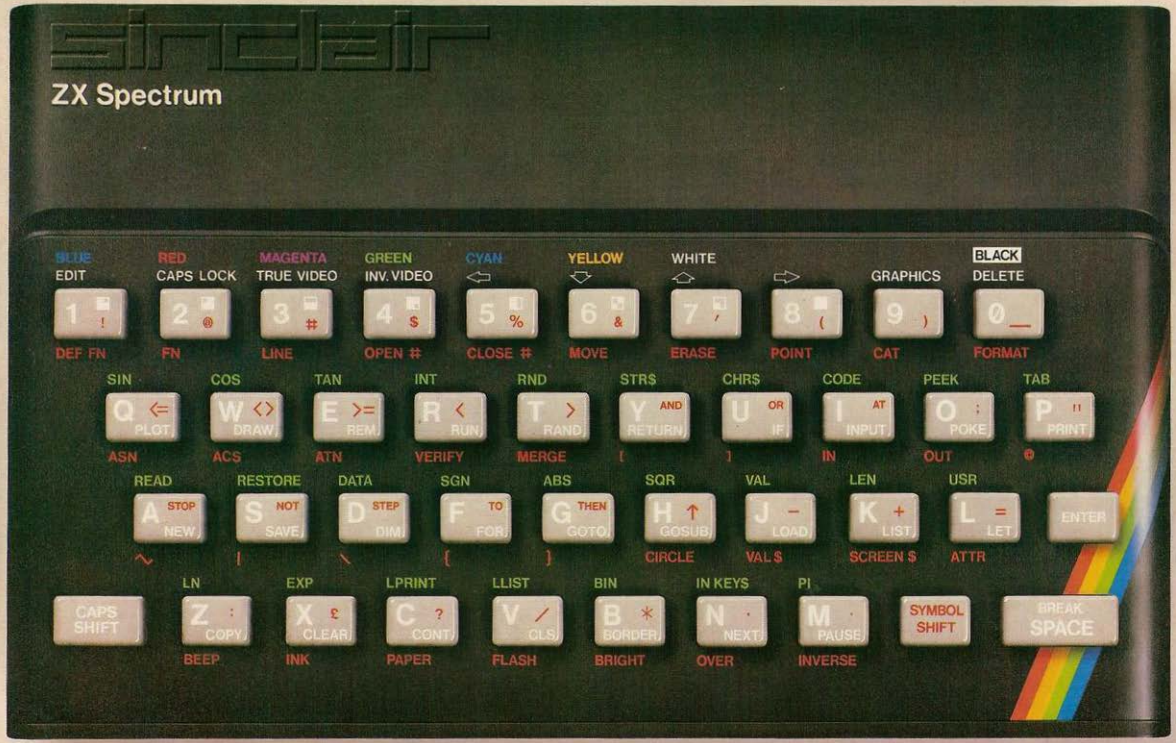
The locations which we are interested in are as follows:

	Low byte	High byte	Address
Start of Basic on unexpanded Vic	43 1	44 16=	4097
Start of variables	45	46	
Start of arrays	47	48	
End of arrays	49	50	
End of strings moving downwards	51	52	
Top of memory on unexpanded Vic	55 0	56 30=	7680

Thus we know that variables are stored in the area which starts at the address pointed to by locations 45 and 46 and finishes at the address pointed to by locations 47 and 48.

The Vic stores all variables regardless of whether they are real, integer or string in a similar way in this area, namely two bytes for name, five bytes for contents — or the address of where the contents are stored in the case of strings. But if only two bytes are used for the variable name, how does the Vic store the three significant characters that it requires to define each variable? It does this by adding 128 to the first or second character depending on the type of variable. For example, the real — floating point — variable AA will be stored as 65 65 where 65 is the ASCII code for A. The variable AA$ will be stored as 65 193 — that is 65 (65+128). The variable AA% will be stored as 193 193.

(continued on page 101)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J − LOAD
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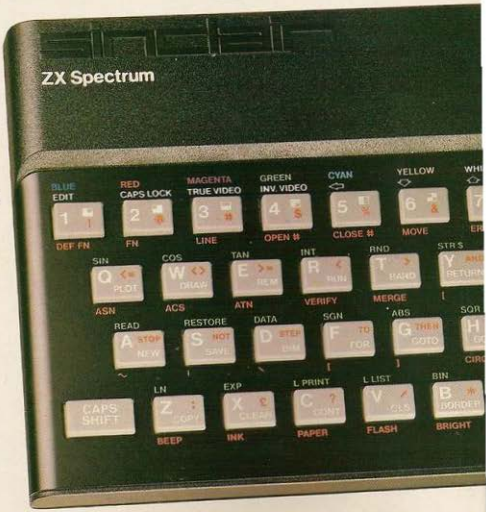

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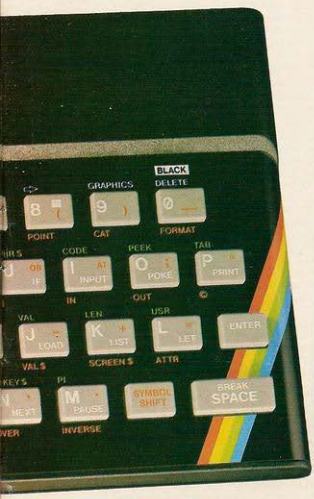

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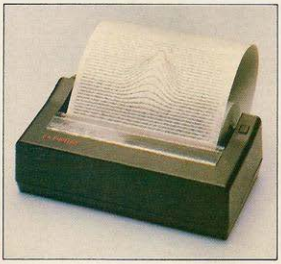

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Sinclair ZX Spectrum–technical data.

Dimensions

Width	233 mm
Depth	144 mm
Height	30 mm

CPU/ memory

Z80A microprocessor running at 3.5 MHz.
16K-byte ROM containing BASIC interpreter and operating system.

16K-byte RAM (plus optional 32K-byte RAM on internal expansion board) or 48K-byte RAM.

Keyboard

40-moving-key keyboard with full upper and lower case with capitals lock feature. All BASIC words obtained by single keys, plus 16 graphics characters, 22 colour control codes, and 21 user-definable graphics characters. All keys have auto repeat.

Display

Memory-mapped display of 256 pixels x 192 pixels; plus one attributes byte per character square, defining one of eight foreground colours, one of eight background colours, normal or extra brightness and flashing or steady. Screen border colour also settable to one of eight colours. Will drive a PAL UHF colour TV set, or black and white set (which will give a scale of grey), on channel 36.

Sound

Internal loudspeaker can be operated over more than 10 octaves (actually 130 semitones) via basic BEEP command. Jack sockets at the rear of computer allow connections to external amplifier/ speaker.

Graphics

Point, line, circle and arc drawing commands in high-resolution graphics.
16 pre-defined graphics characters plus 21 user-definable graphics characters. Also functions to yield character at a given position, attribute at a given position (colours, brightness and flash) and whether a given pixel is set. Text may be written on the screen on 24 lines of 32 characters. Text and graphics may be freely mixed.

Colours

Foreground and background colours, brightness and flashing are set by BASIC INK, PAPER, BRIGHT and FLASH commands. OVER may also be set, which performs an exclusive–or operation to overwrite any printing or plotting that is already on the screen. INVERSE will give inverse video printing. These six commands may be set globally to cover all further PRINT, PLOT, DRAW or CIRCLE commands, or locally within these commands to cover only the results of that command. They may also be set locally to cover text printed by an INPUT statement. Colour-control codes, which may be accessed from the keyboard, may be inserted into text or program listing, and when displayed will override the globally set colours until another control code is encountered. Brightness and flashing codes may be inserted into program or text, similarly. Colour-control codes in a program listing have no effect on its execution. Border colour is set by a BORDER command. The eight colours available are black, blue, red, magenta, green, cyan, yellow and white. All eight colours may be present on the screen at once, with some areas flashing and others steady, and any area may be highlighted extra bright.

Screen

The screen is divided into two sections. The top section – normally the first 22 lines – displays the program listing or the results of program or command execution. The bottom section – normally the last 2 lines – shows the command or program line currently being entered, or the program line currently being edited. It also shows the report messages. Full editing facilities of cursor left, cursor right, insert and delete (with auto-repeat facility) are available over this line. The bottom section will expand to accept a current line of up to 22 lines.

Mathematical operations and functions

Arithmetic operations of +, –, ×, ÷, and raise to a power. Mathematical functions of sine, cosine, tangent and their inverses; natural logs and exponentials; sign function, absolute value function, and integer function; square root function, random number generator, and pi.

Numbers are stored as five bytes of floating point binary – giving a range of $+3\times10^{-39}$ to $+7\times10^{38}$ accurate to 9½ decimal digits.

Binary numbers may be entered directly with the BIN function. =, >, <, >=, <= and <> may be used to compare string or arithmetic values or variables to yield 0 (false) or 1 (true). Logical operators AND, OR and NOT yield boolean results but will accept 0 (false) and any number (true).

User-definable functions are defined using DEF FN, and called using FN. They may take up to 26 numeric and 26 string arguments, and may yield string or numeric results.

There is a full DATA mechanism, using the commands READ, DATA and RESTORE.

A real-time clock is obtainable.

String operations and functions

Strings can be concatenated with +. String variables or values may be compared with =, >, <, >=, <=, <> to give boolean results. String functions are VAL, VAL$, STR$ and LEN. CHR$ and CODE convert numbers to characters and vice versa, using the ASCII code.

A very powerful string slicing mechanism exists, using the form a$ (x TO y).

Variable names

Numeric – any string starting with a letter (upper and lower case are not distinguished between, and spaces are ignored).
String – A$ to Z$.
FOR-NEXT loops – A-Z.
Numeric arrays – A-Z.
String arrays – A$ to Z$.

Simple variables and arrays with the same name are allowed and distinguished between.

Arrays

Arrays may be multi-dimensional, with subscripts starting at 1. String arrays, technically character arrays, may have their last subscript omitted, yielding a string.

Expression evaluator

A full expression evaluator is called during program execution whenever an expression, constant or variable is encountered. This allows the use of expressions as arguments to GOTO, GOSUB, etc.

It also operates on commands allowing the ZX Spectrum to operate as a calculator.

Cassette interface

The ZX Spectrum incorporates an advanced cassette interface. A tone leader is recorded before the information to overcome the automatic recording level fluctuations of some tape recorders, and a Schmitt trigger is used to remove noise on playback.

All saved information is started with a header containing information as to its type, title, length and address information. Program, screens, blocks of memory, string and character arrays may all be saved separately.

Programs, blocks of memory and arrays may be verified after saving to confirm successful saving.

Programs and arrays may be merged from tape to combine them with the existing contents of memory. Where two line numbers or variables names coincide, the old one is overwritten.

Programs may be saved with a line number, where execution will start immediately on loading.

The cassette interface runs at 1500 baud, through two 3.5 mm jack plugs.

Expansion port

This has the full data, address and control busses from the Z80A, and is used to interface to the ZX Printer, the RS232 and NET interfaces and the ZX Microdrives.

IN and OUT commands give the I/O port equivalents of PEEK and POKE.

ZX81 compatibility

ZX81 BASIC is essentially a subset of ZX Spectrum BASIC. The differences are as follows.

FAST and SLOW: the ZX Spectrum operates at the speed of the ZX81 in FAST mode with the steady display of SLOW mode, and does not include these commands.

SCROLL: the ZX Spectrum scrolls automatically, asking the operator "scroll?" every time a screen is filled.

UNPLOT: the ZX Spectrum can unplot a pixel using PLOT OVER, and thus achieves unplot.

Character set: the ZX Spectrum uses the ASCII character set, as opposed to the ZX81 non-standard set.

ZX81 programs may be typed into the ZX Spectrum with very little change, but may of course now be considerably improved. The ZX Spectrum is fully compatible with the ZX Printer, which can now print out a full upper and lower case character set, and the high resolution graphics; using LLIST, LPRINT and COPY. ZX81 software cassettes and the ZX16K RAM pack will not operate with the ZX Spectrum.

sinclair
ZX Spectrum

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Program 1. The variable lister.

```
63000 PRINT"J":Z8=PEEK(45)+256*PEEK(46)
63001 Z9=0:IFZ8>=PEEK(47)+256*PEEK(48)THENEND
63002 IFPEEK(Z8)>127THENPRINTCHR$(PEEK(Z8)-128);:Z9=37:GOTO63004
63003 PRINTCHR$(PEEK(Z8));
63004 Z8=Z8+1:IFPEEK(Z8)<128THENPRINTCHR$(PEEK(Z8));:GOTO63006
63005 PRINTCHR$(PEEK(Z8)-128);:IFZ9=0THENZ9=36
63006 PRINTCHR$(Z9),:Z8=Z8+6:GOTO63001
```

(continued from page 96)

The Vic places variables into the variable storage area as and when it encounters them in a Basic program. In the following program, A would be stored first, then B, then C$.

10A = 1:B = 10:C$ = "C"

Program 1 is a utility which will list all the variables' names used in a Basic program. It uses two variables itself, Z8 and Z9, and takes up about 230 bytes.

Line 63000 clears the screen and sets Z8 to the address of the start of variables.

Line 63001 sets 9 to zero. Thus if we subsequently

PRINTCHR$(Z9)

it will print the ASCII null mentioned earlier. This also checks whether Z8 is equal to or greater than the address of the end of variables. This step is obviously redundant for the first pass through the program.

Line 63002 checks whether the character stored at address Z8 is greater than 127 and if it is, subtracts 128 to give us a printable character in the range A to Z. Z9 is then set to 37 which means a subsequent

PRINTCHR$(Z9)

will give a % character — that is, we have detected an integer variable as the first character is greater than 127.

Line 63003 prints the character if it was originally less than 127.

Line 63004 increments Z8 by 1 so that we are now looking at the second character of our variable name and a similar process to that in line 63002 is performed.

Line 63005 sets Z9 to 36 — the character code for $ — if it has not already been set to the % code.

Line 63006 prints Z9 which can now be 0, 36($) or 37(%), and then increments Z8 by 6 to pick up the first character of the next variable name. The program then loops back to line 63001 to continue the process.

How do you use this utility? It needs to be in memory with the main Basic program whose variables you want to list. More of how to get it in later. You must then Run your program and when it ends type

GOTO63000

This will start the utility, the screen will clear and the variables encountered in the Basic program will be listed. Ignore Z8 and Z9 which are listed at the end — they belong to the utility itself. Do not type Run63000 or all you will get is Z8 and Z9 on their own. This is because Run automatically does a Clr which clears the variable storage area.

If your main Basic program does not end but, say, continuously loops, press Run/Stop and Restore keys, then type

GOTO63000

The variables used will still be in the variable storage area. Remember, though, that they are placed there only as and when encountered by your Basic program, so try to ensure that it is run for long enough, or all possible subroutines are entered before pressing the Run/Stop, Restore keys or some variables may be left off your list.

Now how do we get the utility into memory? Well, one way is to Load your main program from cassette and then to type in the utility from the listing. Ensure that you do not already use lines 63000 and 63006 inclusive, of course, or you will overwrite them. This is obviously tedious and prone to errors. You cannot Load the utility from cassette as this automatically clears memory first and would thus delete your main program.

What is needed is the ability to merge or append programs — but this facility is not available on the Vic — or is it?

The following procedure was devised by Jim Butterfield — a Commodore Vic supremo. The trick is to save the utility on to cassette not as a standard binary file but as an ASCII data file and then to fool the Vic into accepting keyboard entry from the cassette.

Here is the procedure — it is a little complicated but mighty handy in lots of cases. First type in the utility from the listing. Save in the normal way typing

SAVE "VARIABLES"

This will give you a normal binary file as a back up in case anything goes wrong. Now type

OPEN1,1,1,"VARIABLES(ASCII)":CMD1:LIST

Press Record and Play on the tape cassette when asked to do so.

When the tape stops type

PRINT# 1: CLOSE1

You now have the utility saved as an ASCII file. What we did here was to Open the cassette for a Write operation; set the Vic output from the screen to the cassette; and then listed the program not to the screen but direct on to the cassette. We then closed the file and returned everything to normal.

Now to merge this with your Basic program which is already in memory. Firstly, make sure that you rewind the tape to the beginning of the utility ASCII file. Then type

POKE19,1:OPEN1

and press Return. Press Play on tape and the cassette will search for the file, finally reporting:

FOUND VARIABLES (ASCII)

Clear the screen and type exactly three cursor downs so that you are now on line four. Type ?"(home)":POKE198,1:POKE631,13:POKE153,1 and press Return. Note that (home) means the Clr Home key.

The motor will whirr into life and after a short time an error message will display on the screen. Ignore it.

If you now List you will find the utility tucked on to the end of your Basic program and you can Run and Goto 63000 as previously described.

This merging technique is also very useful for adding your favourite subroutines to a program already in memory.

Different programming techniques are generally required if you are trying to save space or trying to speed up a program. Unfortunately it is sometimes difficult to do both at once. If you are trying to save space, use single characters for variable names and minimise the number of variables that you use. Remember each new variable needs seven bytes in the variable storage area, and that string variables also need space in the string data area to store their text. To speed up a program you need to ensure that a specific variable can be found quickly by the Basic interpreter. You remember how Basic allocates variables into the variable storage area as and when it encounters them in the Basic program? Every time the Basic interpreter encounters a variable, it jumps to the variable storage area and sequentially scans along until it finds that variable name. Obviously, if that variable is first in the list, it finds it faster than if it is the last in the list. Thus to speed up the process we need to ensure that speed-critical variables, or the most commonly-used variables, are at the front of the list. We can do this by assigning them to dummy values in the first line of our Basic program.

If you are using a constant value in several places in a program it will speed up operation if you assign a variable name to it. For example if you are using the constant 32897.123 a lot, this uses up nine bytes every time it occurs. It also slows down the operation as Basic has to read in all nine characters and convert them to a floating-point number for internal use. An initial assignment of A=32897.123 will not only save you memory but time as well. ■

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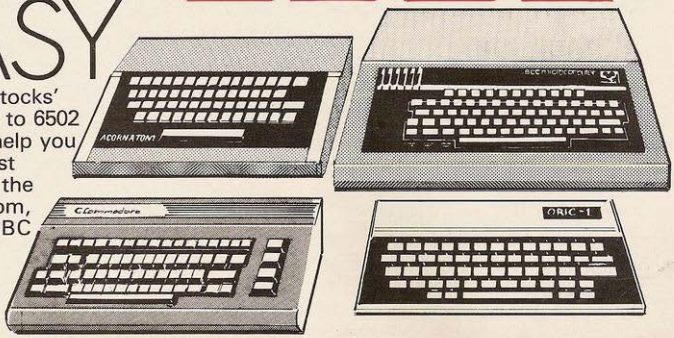

MACHINE CODE

THIS ARTICLE is aimed at those of you who would normally read the words machine code, scream, and turn the page quickly. If you have done this in the past, now is the time to change. Did you realise that Basic itself is a machine-code program, and that every instruction such as Print, Let and Poke is converted into machine code, and then run as machine-code subroutines? This tends to make Basic very slow — a machine-code program is in the order of 100 times faster than its Basic equivalent.

As in Basic, machine code is made up of a series of instructions which are executed sequentially — one after the other — starting from the one in the lowest memory location and working up through the memory. As in Basic we have instructions allowing us to jump to a new location — Goto — execute a subroutine and return to the instruction following the subroutine call — Gosub and Return — add number, subtract, conditional jumps — If-Then-Goto — and so on. The only trouble with machine code is that these instructions are set out differently.

A command in machine code is called a mnemonic and the thing that this mnemonic manipulates is called an operand. This is illustrated in figure 1, a short segment of machine code.

Unfortunately, these mnemonics and operands cannot be typed directly into the computer. To speed things up, each mnemonic is represented by a numerical code — varying from 0 to 255. These special codes are called operation codes — op-codes for short — and it is these op-codes that the computer can understand and act on.

In figure 1 then, A9 represents the LDA # command, 85 the STA command and 60 the RTS. Using these op-codes and operands then, we can reduce any program to a series of numbers.

For variables in machine code we have registers. A register is similar to a variable in Basic — that is, it can be set to contain a particular value which can then be added to or subtracted from in a similar pattern to the variables in Basic.

Now here is the catch. We have only five registers, and of those, only three are available to play with. If that is not bad enough, they can only contain integer values from 0-255 inclusive. It may look grim, but let us assess exactly what we have available.

Register symbol	Name
A	Accumulator
X	X register
Y	Y register
SP (or S)	Stack pointer
S (or P)	Status register

The A register is the most used, and most important register of the five. The X register is used mainly as a variable or offset. The Y register is used mainly as a variable or offset. The SP and S registers are pretty tricky and win a separate section of their own later on; but basically the SP shows current position on stack, and S is the basis of conditioned jumps, etc.

Now let us try a simple machine-code program for adding up the two numbers stored in memory locations — from now on referred to as bytes 0 and 1 and storing the result in the second byte — byte 2. The equivalent Basic program to do this would be

POKE 2, PEEK (0) + PEEK (1)

In machine-code this looks like this:

Op-code	Operand	Mnemonic	Comment
18		CLC	Clear the carry bit
A5	00	LDA 0	Load the Accumulator from byte 0
65	01	ADC 1	Add contents of byte 1
85	02	STA 2	Store the Accumulator in byte 2
60		RTS	Return to Basic

(continued on page 107)

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The BBC Microcomputer system is generally regarded to be the best micro in its price range you can lay your hands on. So, if you're thinking of buying one or already own one, you'll want to know about the software that's been specially designed for it.

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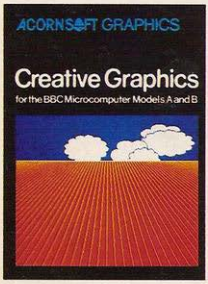
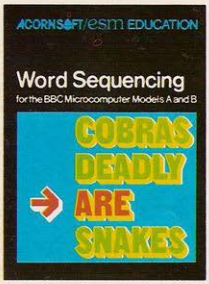
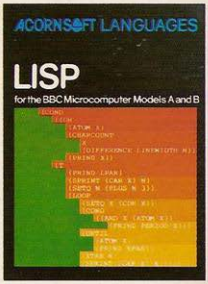
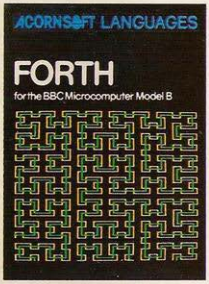




Learn more languages.

LISP (price £24.35) is the fundamental language of artificial intelligence research.





It consists of 5.5K of machine code interpreter, plus 3K of initialised LISP work-space containing utilities and constants. It comes complete with a book that introduces you to programming in LISP, as well as some fascinating applications.

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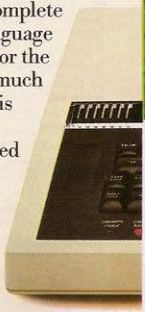

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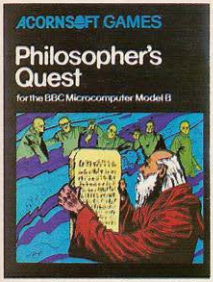

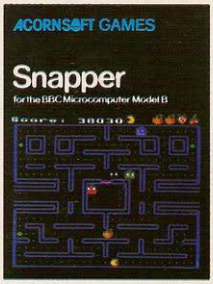

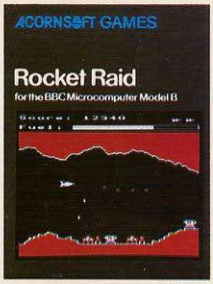

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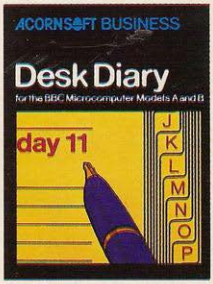

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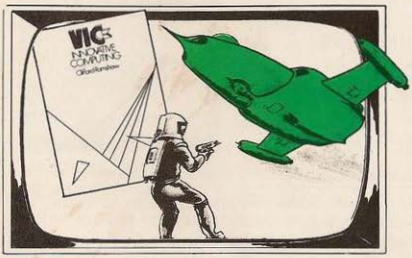

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(continued from page 103)

There is an odd quirk in 6502 when adding up: the only Add command we have is ADC — add with carry. This takes the contents of the carry flag and adds them to the result of the original calculation we were hoping to make. If the carry flag were set then — say it was set to 1 — the result obtained when the ADC is performed would be 1 too high. So the CLC command sets carry equal to zero and we should get the right result.

So now we have our machine code program in the form of op-codes and operands, where can we put this little masterpiece? On the Vic-20, it is best placed directly under the screen memory, as here it will not interfere with Basic at all.

A program to Poke our machine-code program into memory is given in figure 2.

Type it in and Save it. Check lines 50, 60 and 100 especially as any mistake here could cause a crash. When "Finished" appears our program has been loaded into bytes 6700 6707. To run this program we use the Sys command. To run the machine code starting at 6700, type in

SYS 6700

and hit Return. You should get an almost instantaneous reply of "Ready" and the cursor blinking. The machine has run the program, but it was so fast that you did not notice. To check that it has done something try —

PRINT PEEK (00) + PEEK (1), PEEK (2)

As location 2 = location 0 + location 1, the two printed numbers should be the same.

The stack is an area of memory situated around 600-650 reserved for remembering data in a first in last out — FILO — manner. It is called a stack because of its similarities with a stack of other things, for example, plates. If you have a stack of plates and then add a plate to the top of this stack, then the next plate you take from that stack must be the one you have just added. The same is true for our memory stack. The last item to be pushed into the top of the stack will be first to be pulled off it.

It is by using the stack that Basic returns from a subroutine to the right place, knows when it has finished a For-Next loops and so on. The pointer which tells the 6502 what position it is at in the stack is the stack pointer register SP. As return addresses are added to the stack each time a subroutine call is made, it is best to avoid using the stack as much as possible. Unless you keep a strict record of what exactly you are doing, what you put in might not be what you get out at some later date.

The status register — SR — is better considered as a group of eight bits rather than just one byte. It contains seven flags and one unused bit. They appear as —

Bit number	7	6	5	4	3	2	1	0
Symbol	N	V	—	B	D	I	Z	L

Bit 7 is the sign bit. It is set whenever a result from Add instruction is a negative number in two's complement format. Translating this, it means that N bit will be the same as Bit 7 in the accumulator after many operations.

Bit 6 is the overflow flag used in two's complement subtraction when the result could be wrong due to a carry from Bit 6 to Bit 7. Bit 5 is unused.

Op-code	Operand	Mnemonic	Operand	Basic equivalent
A9	03	LDA#	03	A = 03
85	05	STA	05	Poke 5, A
60		RTS		Return

Figure 1.

Bit 4 is the Break flag and is set after the Brk instruction to let us know that it is a software, not hardware, break. Bit 3 is the Decimal flag and informs the processor whether to use BDC or binary representations of data. Bit 2 is the interrupt flag, when set, it will prevent any interrupts.

Bit 1 is my personal favourite. This is the zero flag and is used to indicate that the result of any particular operation equals zero.

Bit 0 is the carry flag which is used for a carry during additions. It can often be thought of as an eighth bit during additions. These flags form the basis of all the Conditional Jumps in 6502 assembly.

We get the following branches:

		Branch	**Status register**
BCC	—	if carry clear	C = 0
BCS	—	if carry set	C = 1
BEG	—	if equal to 0	Z = 1
BMI	—	if minus (negative)	N = 1
BNE	—	if not equal to 0	Z = 0
BPL	—	if plus (positive)	N = 0
BVC	—	if overflow clear	V = 0
BVS	—	if overflow set	V = 1

These branches correspond to the If-Then-Goto sequence, except that one does not specify a branch and an address but a branch and a displacement between 127 and –126. This displacement is added to the program counter — PC, or two-byte register which contains the address of the instruction currently being executed — to send it either forward or backward by that displacement.

To illustrate this, here are two programs; the first clears the screen, the second zips up and down the music scales. The asterisks on the programs indicate a memory byte to be skipped in the branch instruction.

Assembly code	**Mnemonics**
A2 00	LDX # 0
A9 20	LDA # $20
9D* 00* 1E*	STA $1E00,X
9D* 00* 1F*	STA $1F00,X
CA*	DEX
D0* F8*	BNE $F8
60	RTS

```
10 POKE 56, 26: POKE 52, 26: REM
   RESERVE SPACE FOR THE
   PROGRAM
20 COUNT = 0: REM POINTER TO
   DATA
30 READ D$ : IF D$ = "*" THEN PRINT
   "FINISHED" ": END
40 D1$ = LEFT $ (D$,1) : D2$ = RIGHT
   $ (D$,1) : REM CONVERT
   HEXADECIMAL
50 V = (ASC (D1$) - 48 + ((ASC (D1$)
   >64) *7)) *16 :
60 V = V + (ASC (D2$) - 48 + ((ASC
   (D2$)>64) * 7)) : REM DECIMAL
70 POKE 6700 + COUNT, V : REM
   STORE THE MACHINE CODE IN 6700
   ONWARDS
80 PRINT (6700 + COUNT) ; V : COUNT
   = COUNT + 1 : GOTO 30 : REM
   REPEAT FOR NEXT BYTE
99 REM : HERE IS THE DATA OF THE
   PROGRAM
100 DATA 18, A5, 00, 65, 01, 85, 02, 60:
110 DATA * : REM END OF DATA.
```

Figure 2.

The Basic equivalent of this program would look like this:

```
10 X = 256
20 A = 32
30 Poke 7680 + X, A
40 Poke 7936 + X, A
50 X = X - 1
60 IF X <> 0 Then 30
70 END
```

The F8 in the branch instruction is the displacement mentioned and is obtained thus: count how many bytes are needed to skip backward, in this case 89. Then this is converted to eight-bit binary. One's complement is then calculated in binary and 1 is added to obtain two's complement. The resultant sum looks like this:

```
   = 89
   = 00001001
   = 11110110
   = 11110110
            1 +
   ----------
   = 11110111
```

The eight-bit binary is then converted to two-bit hex: F7 is the result. If a line 5 is added to the Basic program

5 FOR I = 0 TO 512 : POKE 7680 + I, 160 : NEXT

and the rest entered and Run, this will show you what the machine-code program does. To enter the machine code, change line 100 in figure 2 to:

100 Data A2,00,A9,20,9D,00,1E,9D,00,1F,CA, D0,F8,60

Do not forget to Save, then Run, just in case. To run the machine code try Sys 6700. The program should respond with a blank screen and a "Ready" plus cursor.

Here is the second program.

Op-code	**Operand**	**Mnemonic**
A9	0F	LDA # 0F
8D	0E 90	STA 90DE
A2	FF	LDX# FF
A0	00	LDY # 00
CA*		DEX
8E*	0A* 90*	STX 900A
8C*	0B* 90*	STY 900B
C8*		INY
F0*	F6	BEQ F6
60		RTS

The Basic equivalent looks like this:

```
10 A = 15
20 POKE 36878,A
30 X = 255
40 Y = 0
50 X = X-1
60 POKE 36874,X
70 POKE 36875,X
80 Y = Y + 1
90 IF Y = 0 OR Y = 256 THEN 50
100 END
```

The F6 in the branch-if-equal-to-0 command is obtained by the same process as was used to obtain F7 previously.

To enter this program change line 100 to

100 Data A9,0F,8D,0E,90,A2,FF,A0,00,CA
102 Data 8E,0A,90,8C,0B,90,C8,F0,F6,60

When the program has been Saved, try Sys 8700. This will Run the program, but it may be a bit fast, so until next time, can you think of a machine-code routine to slow it down? ■

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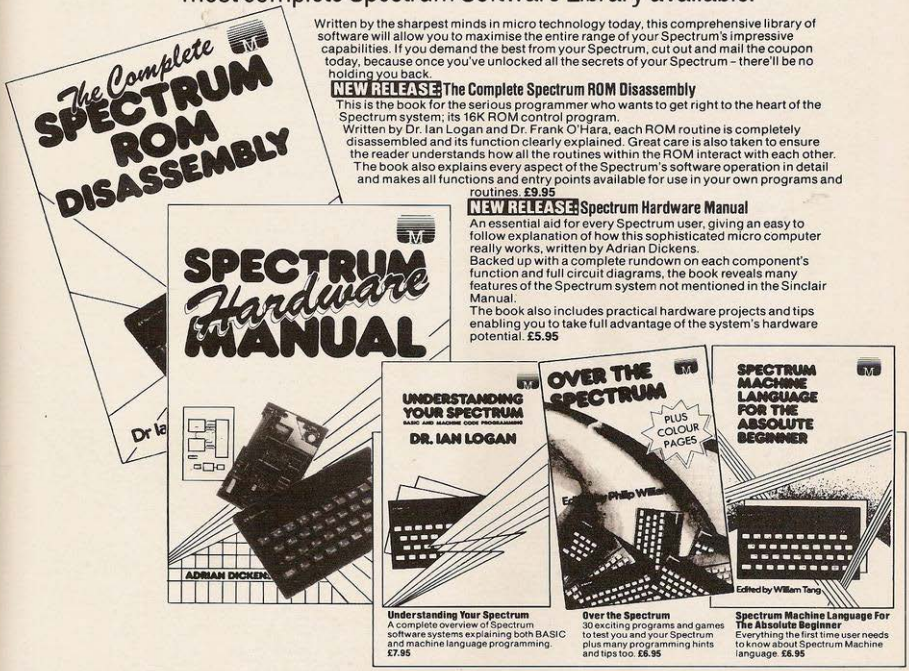

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SPECTRUM ANIMATION

Blast off into a new fast-action, flicker-free universe with Robert Newman's smooth-animation machine-code routines.

16K AND 48K

THE PROVISION of colour, sound and user-definable high-resolution graphics on the Sinclair Spectrum encourages many people to try writing arcade-style games for their computer. Such programs require fast-action, flicker-free graphics if they are to be successfull and excitingly implemented on Spectrums.

The usual method of producing the illusion of movement involves first printing an object at one position, and then erasing it and printing one character position further along the screen. This method is certainly fast enough when used in Basic programs on the Spectrum if only one or two graphics characters require animation, but the movement has a jerky appearance, because the smallest distance that a character can be moved is one print position. There are only 32 positions across the screen, or 22 from top to bottom.

Another disadvantage of Basic is that the action slows down noticeably when several characters are required to move, or if the graphics are large, involving printing on a number of lines or across several columns. Most commercially-written software uses machine code in order to achieve the required speed and smoothness of movement, but writing an entire game in machine code is not a task that most home programmers would relish. It is therefore necessary to consider other methods for speeding up the action in Basic programs.

Smooth routine

On the ZX-81 it is possible to short-cut the Print statement by Poking characters directly into the display file, thereby getting slightly faster graphics. Unfortunately the Spectrum's display file is laid out in a very complicated fashion — see page 164 of the manual — and it is not really feasible to do the same thing on this computer.

For this reason I have written a machine-code routine especially for the purpose of enabling games programmers to obtain faster, smoother animation from Basic. It is intended to be used with user-defined graphics characters, which can be made as large as

(continued on next page)

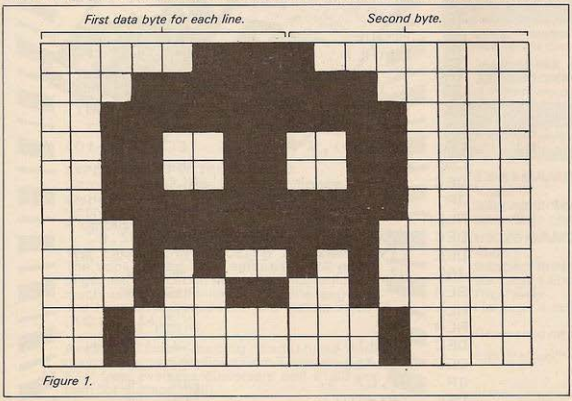

Figure 1.

Figure 2.

Listing 5.

```
  1 REM multicoloured invaders
  2 REM © R Newman 1983
  3 REM 48K version
  4 REM ----------------------
  5 CLEAR 65159
 10 PAPER 7: BORDER 7: CLS
 20 FOR y=160 TO 100 STEP -20
 30 GO SUB 100
 40 NEXT y
 50 INK 0
 60 STOP
 70 REM ************************
100 POKE 65162,14: POKE 65164,1
110 FOR x=0 TO 100 STEP 2: GO S
UB 200: NEXT x
120 FOR x=100 TO 0 STEP -2: GO
SUB 200: NEXT x
130 POKE 65160,0: POKE 65161,y
140 POKE 65162,140: POKE 65163,
13
150 POKE 65164,0
160 RANDOMIZE USR 65171
170 RETURN
180 REM ************************
200 POKE 65161,y: POKE 65160,x
210 POKE 65165,1
220 GO SUB 300
230 POKE 65161,y-9: POKE 65163,
2
240 POKE 65165,4
250 GO SUB 300
260 RETURN
270 REM ************************
300 FOR c=0 TO 6: PRINT INK c;
310 POKE 65160,c*20+x
320 RANDOMIZE USR 65171
330 NEXT c
340 RETURN
350 REM ************************
```

(continued from previous page)

desired and printed by a single call to the routine. In addition, the graphics can be located at any position on the 256 × 176 high-resolution screen, and can therefore be made to move by as little as one point at a time. This is a considerable improvement over the coarse 32 × 22 resolution normally obtainable. The colour of the graphics can be controlled from Basic with the normal Ink, Paper, Bright and Flash statements.

The machine code occupies 197 bytes, and the safest way to store it is to move RAMtop downwards in memory, using the Clear command, and place the code between the Basic area and the user-defined graphics.

The address of the routine will therefore be different for 48K and 16K Spectrums. The routine itself, however, is the same for both computers, and a dump of the machine code is given in listing 1. Owners of 48K machines can use the loader program in listing 2. Enter this program and Run it, inputting the numbers from listing 1 as prompted: read the numbers from left to right. I would advise you to check the machine code before Saving it or attempting to use it. This can be done with the

(continued on page 115)

Listing 1. Machine-code dump.

```
2   175 8   8   1   1   40  9   7   221 53  10
0   0   0   0   0   221 221 53  7   32  247 203
42  178 92  221 35  42  33  203 16  23  221 53
123 92  221 94  5   29  10  221 53  6   32  19
203 35  203 35  203 35  221 53  10  40  6   7
22  0   25  235 221 78  221 53  10  32  250 119
0   221 70  1   221 126 193 241 5   61  32  155
3   245 197 221 126 2   201 221 53  9   32  10
221 119 6   205 170 34  221 203 4   70  40  4
221 119 7   221 52  7   235 35  78  235 221 53
47  230 7   60  221 119 8   32  204 221 53  10
8   213 229 205 219 11  40  6   7   221 53  10
225 209 221 203 4   70  32  250 119 35  213 229
32  5   1   0   0   24  245 205 219 11  241 225
5   235 70  35  78  235 209 221 54  8   8   221
221 54  9   8   221 54  54  7   1   24  153
10  9   126 221 53  7
```

Listing 3. Disassembled machine-code.

```
        ORG  65160
XPOS    DEFB 2
YPOS    DEFB 175
WIDTH   DEFB 8
HT      DEFB 8
MODE    DEFB 1
UDGCH   DEFB 1
        DEFB 0
        DEFB 0
        DEFB 0
        DEFB 0
        DEFB 0
;
START   LD   IX,(23730)
        INC  IX
        LD   HL,(23675)
        LD   E,(IX+5)
        DEC  E
        SLA  E
        SLA  E
        SLA  E
        LD   D,0
        ADD  HL,DE
        EX   HL,DE
        LD   C,(IX+0)
        LD   B,(IX+1)
        LD   A,(IX+3)
LINE    PUSH AF
        PUSH BC
        LD   A,(IX+2)
        LD   (IX+6),A
        CALL 22AAH
        LD   (IX+7),A
        INC  (IX+7)
        CPL
        AND  7
        INC  A
        LD   (IX+8),A
        PUSH DE
        PUSH HL
        CALL 0BDBH
        POP  HL
        POP  DE
        BIT  0,(IX+4)
        JR   NZ,5
        LD   BC,0
        JR   LN1
        EX   HL,DE
        LD   B,(HL)
        INC  HL
        LD   C,(HL)
        EX   HL,DE
LN1     LD   (IX+9),8
L1      LD   (IX+10),9
        LD   A,(HL)
        DEC  (IX+7)
        JR   Z,L3
L2      RLCA
        DEC  (IX+10)
        DEC  (IX+7)
        JR   NZ,L2
L3      SLA  C
        RL   B
        RLA
        DEC  (IX+10)
        DEC  (IX+6)
        JR   NZ,L7
        DEC  (IX+10)
        JR   Z,L6
L5      RLCA
        DEC  (IX+10)
        JR   NZ,L5
L6      LD   (HL),A
        POP  BC
        POP  AF
        DEC  B
        DEC  A
        JR   NZ,LINE
        RET
L7      DEC  (IX+9)
        JR   NZ,L4
        BIT  0,(IX+4)
        JR   Z,L4
        EX   HL,DE
        INC  HL
        LD   C,(HL)
        EX   HL,DE
L4      DEC  (IX+8)
        JR   NZ,L3
        DEC  (IX+10)
        JR   Z,L8
L9      RLCA
        DEC  (IX+10)
        JR   NZ,L9
        JR   NZ,L3
L8      LD   (HL),A
        INC  HL
        PUSH DE
        PUSH HL
        PUSH AF
        CALL 0BDBH
        POP  AF
        POP  HL
        POP  DE
        LD   (IX+8),8
        LD   (IX+7),1
        JR   L1
;       END
```

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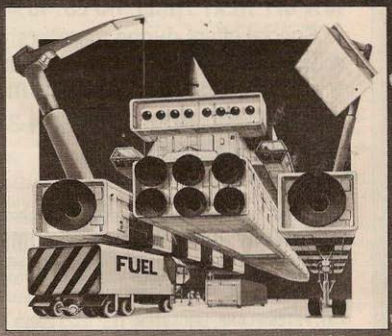

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(continued from page 112)

same loader program by deleting lines 20, 30, 70 and 90, and changing line 80 to:

80 PRINT TAB 10; PEEK i

If all is correct, you should Save the routine with the command:

SAVE "animate" CODE 65160,197

Owners of 16K computers need to make the following changes. In listing 2, change line 20 to

CLEAR 32389

and line 50 to

FOR i=32390 TO 32586

Save the routine with the command

SAVE "animate" CODE 32390,197

You can now test the routine by clearing the screen and issuing the command:—

RANDOMIZE USR 65171 48K
RANDOMIZE USR 32401 16K

Whereupon the character in user-defined graphic "a" — usually a capital letter A — should appear at the top left-hand corner of the screen. If this does not happen you have made a mistake while entering the machine code.

If the computer has crashed you must remember to reset RAMtop by giving the appropriate Clear command before reloading your copy of the routine and checking it.

If all went as expected, here is how to use the routine from a Basic program. If you examine the disassembled routine in listing 3, you will see that the first 6 bytes are used as variables, XPOS, YPOS and so on. These names will not be recognised if you try to use them in a Basic program, but by Poking different values into these six bytes you can control the operation of the routine as follows.

Routine control

XPOS — address 32390 for 16K, 65160 for 48K — is the X co-ordinate of the top left-hand corner when the graphic character is printed on the screen. Possible values are the same as are allowed for the PLOT command, that is 0 to 255.

YPOS — address 32391 or 65161 — is the Y coordinate of the top left-hand corner of the graphic character when printed on the screen. It may take values from 0 — bottom of screen — to 175 — top of screen.

Width — address 32392 or 65162 — this is the number of points left-right in the character to be printed.

HT — address 32393 or 65163 — is the number of points top-bottom in the character to be printed.

Mode — address 32394 or 65164 — has the value 1 if you wish to print a character at the current position, or 0 if you wish to erase a block of Width × HT points at the current position.

UDGCH — address 32395 or 65165 — this must have a value from 1 to 21, and it tells the routine where to find the data for the character that you want to print. A value of 1 means that the first byte of data is held at address USR "a", that is, the first byte of the user graphic "a", while a value of 21 means that it is held in address USR "u".

Values Poked into these six bytes before calling the routine will be unchanged on exit, so, if printing more than one character, you may not need to update every byte. You will get strange results, or possibly cause a crash if you attempt to set XPOS and YPOS to values which do not permit the character you wish to print to fit onto the screen, and so your Basic program may need to include a check to prevent this.

Different colours

The routine prints the graphic character in the colour defined by the current contents of system variable ATTR T — location 23695. If you want to print characters in different colours, you can set ATTR T from Basic without changing the current print position by using a dummy Print statement such as

PRINT PAPER 6; INK 1;

before calling the routine. The Flash and Bright statements can also be used.

If you use the routine to print user-graphics consisting of eight-by-eight points, then the method of storing the pattern is exactly the same as described in chapter 14 of the user manual. However, the routine can handle graphics of any size, and the method for larger characters is slightly different.

Firstly, design your character on a piece of squared paper. I am going to use the routine to move the character across the screen by two points at a time, and so it is best to leave a margin at left and right edges of two blank columns. The operation of moving left or right by two points and printing at the new position will then automatically print over the old space invader, saving the trouble of erasing it first. The character we want to use therefore consists of 14 by 11 points.

If the width is not an exact multiple of eight, you must add the required number of blank columns to the right-hand edge. The width of the character is then divided into eight-bit sections, which can be described by a Bin number as usual and stored in the user-defined graphics area. A program like that in listing 4 can be used for this. The first byte of data for the character is going to be stored in address given by Usr "a". When entering data for your own characters, remember that the data for the top line is stored first, then the second line and so on.

Since the space invader occupies 22 bytes, that is, all of graphics "a" and "b", plus most of "c", the next unused section begins at USR "d". This is where the four bytes of data needed for the character in figure 2 can be stored. When these two lines are printed over the bottom two lines of the space invader, its legs will appear to move while it moves across the screen. Enter and Run listing 4. You can save the user-graphics if you wish with

SAVE "chars"CODE USR "a",32

Erase listing 4 — you can do this with New

Listing 2.

```
10 REM listing 2 (48K)
20 CLEAR 65159
30 CLS : PRINT "enter numbers from
listing 1"
40 PRINT : PRINT "address contents"
50 FOR i= 65160 TO 65356
60 PRINT i;  '
70 INPUT n
80 PRINT TAB 10;n
90 POKE i,n
100 NEXT i

16K users change lines 20 & 50
to:-

20 CLEAR 32389
50 FOR i=32390 TO 32586
```

Listing 4.

```
10 REM character in figure 1
20 FOR i=USR "a" TO USR "a"+21
30 READ n: POKE i,n
40 NEXT i
50 DATA BIN 00000111,BIN 10000000,
  BIN 00011111,BIN 11100000,BIN 00111111,
  BIN 11110000,BIN 00110011,BIN 00110000
60 DATA BIN 00110011,BIN 00110000,
  BIN 00111111,BIN 11110000,BIN 00011111,
  BIN 11100000,BIN 00010100,BIN 10100000
70 DATA BIN 00010011,BIN 00100000,
  BIN 00100000,BIN 00010000,BIN 00100000
  BIN 00010000
80 REM character in figure 2
90 FOR i=USR "d" TO USR "d"+3
100 READ n: POKE i,n
110 NEXT i
120 DATA BIN 00001000,BIN 01000000,
  BIN 00001000,BIN 01000000
```

since the routine and the user-graphics are safe above RAMtop — and enter the program in listing 5. This will make a row of seven multicoloured space invaders walk across and down the screen in the manner so familar to all devotees of the arcade game. Note that all seven invaders can be erased with one call to the routine when moving down a line by setting Mode to 0, Width to 140 and HT to 11 — lines 130-160.

Other sections of the program are as follows: lines 300-340 print the row of seven characters in the seven different Ink colours. Lines 200-260 call the subroutine at line 300 to print first the row of space invaders at a certain position and then overprints their legs with the character in figure 2.

Lines 100-170 make the invaders move first left to right across the screen, and then walk back in the reverse direction. Lines 20-60 make the invaders move down the screen after walking across it.

Fast graphics

From this example, you should be able to see how the routine can be used to advantage in your own programs, producing spectacular, fast-action graphics.

Finally, should you find that the user-defined graphics area is not large enough to store the number or size of characters that you wish to print with this routine, you can relocate the routine and use a larger area of RAM for character storage.

This can be done very easily since the machine-code routine can be put anywhere, provided that its first byte, that is, XPOS, comes immediately after RAMtop. For example, if you wanted to use the routine to generate 40 characters per line printing, you would need to define your own six-by-eight character set, or copy the Sinclair one, missing out the left and right hand margins which give spaces between the letters. This would require a large area of memory — about 800 bytes — for storage, and so 48K owners would need to relocate the routine at, say, address 64000 by issuing a command

CLEAR 63999

and then loading with

LOAD "animate" CODE 64000

The user-defined graphics area can now be moved to start at address 64300 by Poking system variable UDG — location 23675/6 — accordingly. This gives ample space for an alternative character set or for any other user-graphics. ■

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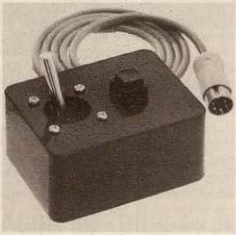

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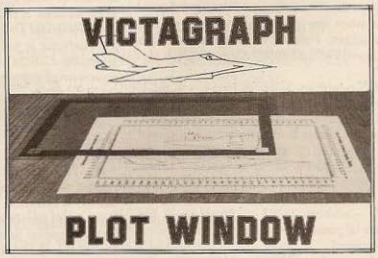

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To do this I used the Z-80 interrupt mode 2. First of all, prepare a tape ready to record the program on, and then type in the listing in figure 1. This is the editor which creates the sounds used in a program. There is an extra line to be inserted in the program missing from the listing printed. It is:

```
755 SAVE "Specsound" CODE 65002,271 :
  PAUSE 50
```

It is important that you check your typing against the listing again when you have finished, to make sure there are no Poke errors, which could crash the program. Do not run the program at this stage, as it contains calls to a machine-code routine you have not yet put in. When you are satisfied with your typing save a copy of the program by typing in

```
SAVE "Specsound 2" LINE 1
```

and Verify it. Leave the tape in position after Verifying.

Now clear the machine by typing

```
PRINT USR 0
```

and input the listing in figure 2. Again when you have finished, check each number against the listing.

Now Run the program. The location and contents of the addresses Poked into will be scrolled up the screen. When it is finished, before Saving it, look at location 65271 on the left and check that it holds the number 251. If there is anything other than that there, you have probably put an extra number in the Data statements, or left one out. Go back and check it again.

Now press a key to save this code straight after the Basic editor. You have now finished the entire program. After doing that, use as a command

```
PAUSE 50:PRINT USR 65002
```

One second later, the number nine should appear and there will be a slight clicking noise. If anything else happens, there is an error.

Clear the machine again — after verifying the code — and load the entire program in from the beginning. The second part will be automatically loaded after the first, and then it will auto-run.

You will see nine numbers, with their names, and a cursor. The cursor is moved by the up and down cursor keys. While the cursor is pointing to a number, that number can be changed. This is done by pressing the left cursor to decrement, and the right cursor to increment. To change more quickly use the 4 key to decrease by 10 and 9 to increase by 10. You cannot go beyond the values 0-255, and the program protects against this.

These numbers actually form a part of the machine code and it is by changing these that you change the sound. To hear a sound at any time, press P. You can do this while another sound is still being put out without danger of crashing.

Now the names to which the numbers are related. First is the starting point. If you think of a complete sound as having a value of 255, changing it to 127 would mean that you would hear it from halfway through compared to the first version.

Second is speed. 0 is the fastest here, and higher values mean the same sound is produced, but more drawn out.

The next four values act against each other inside the routine. The first two control the length and frequency of the click being produced, and the second the gap between the clicks. To find out more about these, experiment with them, but the second number of each pair is usually set to 255. To avoid doing this manually, press T.

The next two should be set either to 1 or 0 as anything over 1 will be taken to mean 1. The first one, if set to 0, causes the pitch to rise. Setting this to 1 does the opposite. The second variable does the same for the silences between the clicks.

The last variable determines the actual quality of the sound, as balanced against the speed penalty. A program requiring high-quality sound will run more slowly than one which is not as critical. Setting 1 is awful, and should not be used; 6 is highest and sounds like a custom-built generator but runs at only 10 percent of normal speed so should only be used in machine-code programs. A useful compromise is 2. Anything over 6 is for special effects. Try it and see.

Technically this number is used as the high byte of a number which is decreased by one when a sound or gap is put out, returning when zero, so six times 256+255 or 1,791 clicks can be put out every interrupt. This is

(continued on page 119)

Figure 1. The sound editor.

```
   1 REM  data for interrupt sou
nd driver
  10 CLEAR 64980
  25 POKE 23692,255
  30 FOR a=65002 TO 65273
  40 READ z: POKE a,z: PRINT a,P
EEK a: NEXT a
  45 SAVE "Specsound"CODE 65002,
271
  60 DATA 58,162,254,60,33,247,9
0,1,9
  70 DATA 0,9,61,32,252,195,174,
254,0,0
  80 DATA 0,0,3,254,0,0,245,197,
213,229
  90 DATA 205,191,2,42,165,254,1
24,181,40,24
 100 DATA 229,33,255,2,58,167,25
4,71,58,169
 110 DATA 254,87,58,47,254,95,58
,168,254,14
 120 DATA 254,201,0,0,33,255,2,1
4,254,30
 130 DATA 14,22,1,123,246,0,230,
255,253,203
 140 DATA 71,70,40,1,47,71,58,72
,92,203
 150 DATA 63,203,63,203,63,246,2
4,237,121,45
 160 DATA 204,132,254,16,248,123
,246,0,230,255
 170 DATA 253,203,71,78,40,1,47,
71,58,72
 180 DATA 92,203,63,203,63,203,6
3,237,121,45
 190 DATA 204,132,254,16,248,21,
82,191,29,32
 200 DATA 186,235,34,165,254,225
,209,193,241,237
 210 DATA 86,251,201,0,0,37,192,
225,34,165
 220 DATA 254,50,168,254,120,50,
167,254,122,50
 230 DATA 169,254,123,50,47,254,
225,209,193,241
 240 DATA 251,237,77,0,0,0,0,0,0
,0
 250 DATA 10,31,1,0,0,0,0,243,25
3,54
 260 DATA 71,0,126,60,50,47,254,
35,126,60
 270 DATA 50,49,254,35,126,50,52
,254,35,126
 280 DATA 50,54,254,35,126,50,84
,254,35,126
 290 DATA 50,86,254,35,126,183,4
0,4,253,203
 300 DATA 71,198,35,126,183,40,4
,253,203,71
 310 DATA 206,35,126,183,32,2,62
,5,50,20
 320 DATA 254,50,43,254,62,253,2
37,71,237,94
 330 DATA 251,201,0
```

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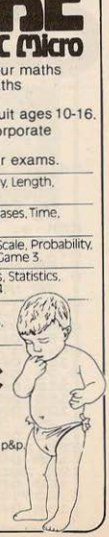

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(Please state ZX-81 (1K), (16K) or BBC Micro or **ZX Spectrum.**

(continued from page 117)
why everything slows down so much when using this number in the length of interrupt variable. 0 is not really useful so the routine sets it to 5.

Of course, one sound is not much good on its own, so room has been made for 28 of them. The red number in the top left of the screen is the field number — 0 to 27 — and is changed by pressing C and then the number of the field you want to work on. A field is unchanged when you are not actually working on it, so you can go back to it at any time. Pressing M moves one field to another. Give the startfield and the destination; the field will be copied and the one put on the screen for you to work on will be the new copy.

To make more copies of this program use Goto 1000. Both parts of the routine will be automatically Saved. Dot not use any Print commands, as the numbers are stored in the printer buffer.

It is recommended that you play around with this routine for a while before actually incorporating any sounds into a program of your own. When you are ready to do this, use the following as guidelines.

Calculate how many sounds you want in a program, and write down the number — starting at 0 — and a description of the sound, that is, what it is meant to represent. Write your game with this in mind.

Inside your program, when you want a sound to be produced at a particular point, just Poke the field number into 65186 and then use the instruction LET sd = USR 65002

While writing these put a Rem in front of them so that if you accidentally Run it, it will not try and execute these instructions. Remember to remove them when the machine-code routine is in place. At the start of your program put these commands

CLEAR 64980: LOAD "Specsound" CODE: LOAD "" CODE

and then Save the program, keeping the tape positioned after the item you have just saved.

Load the editor and create the sounds you want as shown above. When you have finished, press S and then the first field number you want Saving, then the last and finally the name. The machine-code routine will then be copied on to tape, followed by the sounds, and that is all there is to it.

It is possible to Save and Load before a sound has finished. The sound will stop for the duration of these commands, but resume where it left off afterwards. List and Edit can all be performed during sound production. To stop a sound, select a field which is blank and make it produce that sound ■

Figure 2.

```
   1 REM This program is
       © R Seniscal 1982
   2 RESTORE : CLEAR 64980
   3 BORDER 0: PAPER 0: INK 7: C
LS
   4 PRINT INK 6;"wait a moment"
   5 LOAD "Specsound"CODE
   6 REM run 10 if stopped
  10 BORDER 7: PAPER 7: INK 0: C
LS : POKE 65186,0
  12 DIM a(9)
  15 LET pres=23295: LET se=0: L
ET b=12
  16 FOR z=1 TO 9: READ x: LET a
(z)=x: NEXT z
  17 DATA 5,6,8,9,11,12,14,15,17
  19 PRINT INK 4;"↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑
↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑"
  20 PRINT INK 1;TAB 6;"Spectrum
 sound fx"
  30 PRINT INK 2;TAB 6;"© RS 25/
26.12.1982"
  45 PRINT INK 4;"↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑
↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑"
  47 PRINT
  50 PRINT TAB b;"starting point
"
  60 PRINT TAB b;"speed"
  65 PRINT
  70 PRINT TAB b;"lowest pitch (
1)"
  80 PRINT TAB b;"highest pitch
(1)"
  85 PRINT
  90 PRINT TAB b;"lowest pitch (
2)"
 100 PRINT TAB b;"highest pitch
(2)"
 110 PRINT
 120 PRINT TAB b;"reverse (1)"
 130 PRINT TAB b;"reverse (2)"
 135 PRINT
 140 PRINT TAB b;"length of inte
rrupt"
 150 PRINT INK 2;TAB b;"(if 0 th
en length=5)"
 160 PRINT
 170 PRINT TAB 3; INK 7; PAPER 3
;" press ""p"" to hear sound "
 190 PRINT AT 5,0;"  ": PRINT A
T 5,0; INK 2;se;":"
 200 FOR a=1 TO 9: PRINT AT a(a)
,6-(LEN STR$ (PEEK (pres+a))); I
NK 1;PEEK (pres+a)
 210 NEXT a
 230 LET pos=1
 240 IF INKEY$="7" AND pos>=2 TH
EN LET pos=pos-1
 250 IF INKEY$="6" AND pos<=8 TH
EN LET pos=pos+1
 255 FOR z=1 TO 9: PRINT AT a(z)
,7;"    ": NEXT z
 260 PRINT AT a(pos),7; INK 4;"<
"; INK 2;"--"; INK 1;">"
 270 IF INKEY$="" THEN GO TO 270
 280 IF INKEY$="p" OR INKEY$="P"
 THEN LET l=USR 65002
 290 IF INKEY$="c" OR INKEY$="C"
 THEN GO TO 600
 295 IF INKEY$="s" OR INKEY$="S"
 THEN GO TO 700
 300 LET pe=pos+pres
 310 IF INKEY$="9" AND PEEK pe<=
245 THEN POKE pe,(PEEK pe)+10
 320 IF INKEY$="4" AND PEEK pe>=
10 THEN POKE pe,(PEEK pe)-10
 330 IF INKEY$="8" AND PEEK pe<=
254 THEN POKE pe,(PEEK pe)+1
 340 IF INKEY$="5" AND PEEK pe>=
1 THEN POKE pe,(PEEK pe)-1
 350 IF INKEY$="t" OR INKEY$="T"
 THEN BEEP .5,1: POKE (pres+4),2
55: POKE (pres+6),255: GO TO 190
 360 IF INKEY$="m" OR INKEY$="M"
 THEN GO TO 800
 480 REM
 490 PRINT AT a(pos),3;"   ";: P
RINT AT a(pos),6-(LEN STR$ (PEEK
 pe)); INK 1;PEEK pe
 500 GO TO 240
 600 INPUT PAPER 2; INK 7;" numb
er? ";se
 605 IF se>27 THEN GO TO 600
 610 LET pres=9*se+23295
 620 FOR a=1 TO 9: PRINT AT a(a)
,3;"   ": NEXT a
 625 POKE 65186,se
 630 GO TO 190
 700 REM
 710 INPUT PAPER 4; INK 7;"From
which number (inc.)?";from
 720 INPUT PAPER 3; INK 7;"To wh
ich number (inc.)?";to
 730 LET start=23296+9*from: LET
 to=(to-from)*9+9
 740 INPUT "name?";t$
 750 IF t$="" OR LEN t$>10 THEN
GO TO 740
 760 SAVE t$CODE start,to
 770 GO TO 190
 800 REM move
 810 INPUT INK 2;"move from? ";s
ta:
 820 IF sta<0 OR sta>27 THEN GO
TO 810
 830 INPUT INK 2;"move to? ";sta
2:
 840 IF sta2<0 OR sta2>27 THEN G
O TO 810
 850 IF sta=sta2 THEN BEEP 1,-10
: GO TO 810
 855 LET se=sta2
 860 LET sta=23296+sta*9
 870 LET sta2=23296+sta2*9
 880 FOR z=0 TO 8: POKE (sta2+z)
,PEEK (sta+z): NEXT z
 890 BEEP .6,-20
 895 GO TO 610
 999 REM
1000 CLEAR : BEEP 1,-10: BEEP 1,
-20: SAVE "Spexsound2" LINE 1: S
AVE "Specsound"CODE 65002,280
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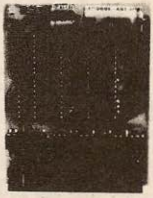

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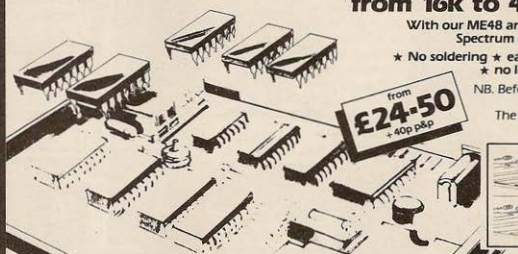

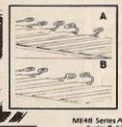

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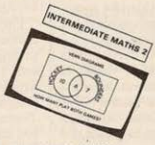

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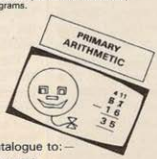

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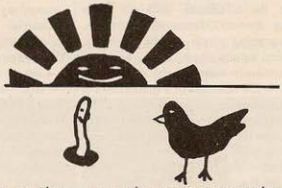

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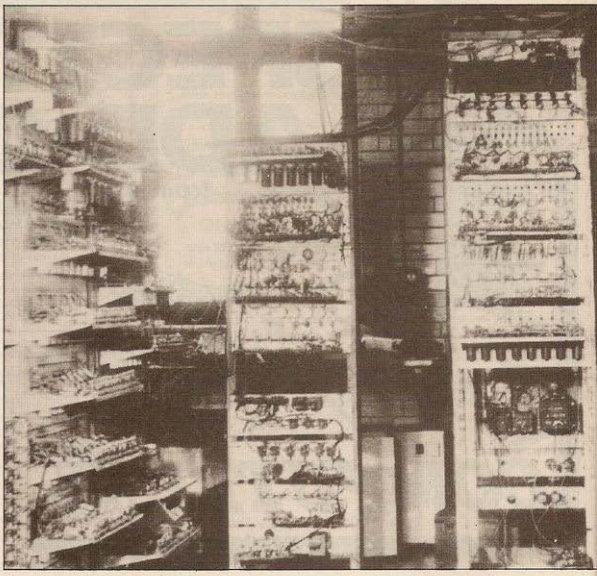
John Dawson looks back at the days when every byte mattered, in his history of software.



SOFTWAR

THE EFFORT required to write software has been a matter of concern since 1946. At that time, M V Wilkes built EDSAC — Electronic Delay Storage Automatic Computer — with a team of helpers at Cambridge University primarily to permit program development. After 1949 this work concentrated on the construction of a library of mathematical subroutines. Wilkes said that "there would be almost as much capital sunk in the library of subroutines as in the machine itself, and builders of new machines in the future might wish to make use of the same order code — machine-code operations — as an existing machine in order that the subroutines could be taken over without modification."

Like the first Manchester and Cambridge computers some early microcomputers had so little memory that hardware was used to start the machine from the first instruction. These front panels allowed the operator to load binary values into the accumulator and other registers. Switches were set to identify the address in the memory and the data which was to be placed at that address. The address switches were then incremented and the new data placed at the next location. By this laborious method it was possible to place a short program into the computer's memory.

In *Faster than Thought* — B V Bowden, Pitman 1953 — it is said "In previous machines the input to the machine had been directly to the cathode-ray tube store from a binary keyboard, and output had been by inspection of a cathode ray tube monitor. For this machine — the second 1949 computer — input and output routines were developed which enabled teleprinter equipment to be controlled by the machine."

This was a great gain in productivity. Remember that the original input looked like figure 1 and you will have no doubt that high-level languages are a great boon to any computer programmer.

At Manchester University, R A Brooker developed the Autocode system which was intended to be a simple, easy to learn programming system for scientific users. Autocode concealed much of the magnetic drum transfer details from users allowing them to concentrate more on the purpose of the program — the solution of a mathematical problem. Autocode provided floating point operations and standard instructions to take information into the machine from a punched paper tape, outputting the result to a teleprinter. Fortran — formula translation — often referred to as the grandaddy of high-level languages did not appear until 1956, two years after the introduction of the Autocode system.

All high-level computer languages translate the instructions that you or I can understand easily into a long series of machine-code instructions which appear to the computer as ones and zeroes. However different the high-level language looks, the translation produces the same machine code and the operation of the central processor unit is precisely the same.

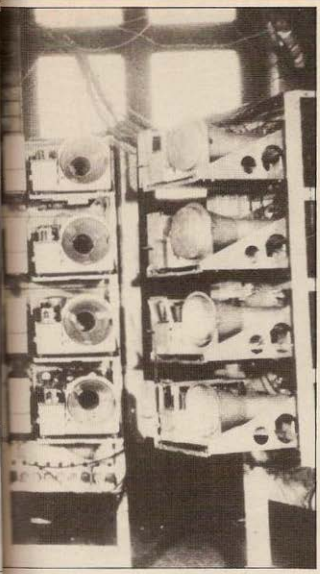
Why are there literally hundreds of high level languages? Some were written for special purposes and are difficult or impossible to use for anything else. Graforth, for example, is a special purpose version of Forth developed for drawing pictures and graphs. It would be almost impossible to use Graforth for office accounting or the continuous control of an industrial chemical plant. Other languages were cramped or limited by the hardware that they were designed for.

Lisp was made to work — or implemented — first on an IBM 704 and some of the instructions in the language take their names from registers inside the computer where the results were to be found — CAR and CDR for example — contents of the address part of register and contents of decrement part of register. You might reasonably have come to the conclusion by now that a great deal of software and many of the languages it is written in are primitive. This is correct.

It is true that the technical revolution has continued with the development of 16- and 32-bit microprocessors but it is also true that there is, at present, no significant software written specifically for these new CPUs and in the microcomputer world we are only beginning to scratch the surface of what can be done using old faithful processors such as the 6502, the 8085 and the Z-80.

The reason for the failure to advance at a comparable rate in software is merely that writing programs is labour intensive, difficult and very time consuming. Programs are written either by one person or by a team of programmers working to a common plan. Teams take longer to complete a project than you might expect because of the overhead time lost in managing the development of the program, making sure that various pieces fit and each section is built according to common design principles. When the development time runs into man, or woman, years, a single designer/programmer might never finish the task or might fail to appreciate some aspect of the program that will prevent it from ever working correctly.

The permutations of the various branches and choices that are made in any significant program are so numerous as to effectively prevent comprehensive testing. Remember that at a microcode level even the designers of the chips themselves make mistakes. The Z-80 CPU made by Zilog contains a number of unlisted instructions which were dropped from the final specification and may or may not work on the chip you possess.



the name was shortened to Forth — another good example of hardware dominance.

Forth is a threaded interpretive language — TIL — and this means that the program that you execute consists of a succession of calls to addresses of lower level instructions. Those instructions may, in turn, call other instructions at the same level or at a lower level until machine code instructions are reached.

Forth has given birth to a family of languages. Stoic is a CP/M version with some advantages, the source program takes up less space and CP/M files are fully supported, while BCPL — Basic Common Programming Language — is an austere TIL with a high degree of flexibility and little error checking. Program development tends to be faster than average using TILs because the nature of the language leads to a modular programming style which, in turn, allows easier debugging of sections of the program as you proceed.

The ease of descent into assembly language and the high level constructions such as If-Then-Else and Repeat-While often provided in TIL assemblers make Forth and its relatives suitable for on-line as opposed to batch processing. Programming in a TIL is a matter of extending the dictionary by building new words out of words that already exist and this, I believe, makes the language ideal for programming by people who are disabled. A microprocessor-based aid for a disabled person could be easily customised to suit the particular requirements of that person and could be altered from day to day by the owner.

Some people believe that as Forth becomes more popular so the need for assembly language programming will disappear. While it is true that Forth has a wide dynamic range — it allows you to move from a very high-level program to naked machine code entirely at will — there is a time penalty to be paid each time a new Forth word is executed. For words containing short sections of machine code the time overhead may be greater than the execution time for the actual operations that you wish to carry out.

A macro-assembler, on the other hand, bridges the gap between a straight assembler producing one machine-code instruction for each line of assembler code and high-level interpreters that will initiate several hundred machine code instructions for each line of the source program. A macro-assembler allows you to define a group of machine code instructions by a name. You may then use the name in your program as a single line and when the source code is assembled to produce an object program that will run on the computer all the instructions that were included in the group are inserted into the object program.

The advantages of this facility are immense. If you make a mistake in the method you use to multiply two numbers then you need only correct the instructions in the macro and wherever that macro-instruction is used in the program it will be put right when you re-assemble the program. A good macro-assembler will allow you to "nest" macro-instructions so that one macro can call another. This feature allows you to build higher and higher level macro-instructions.■

E AND ALL THAT

The 6502 CPU actually contains a mistake in one of the listed instructions — JMP (xxFF) where the xx represents any page number, does not work correctly. If 'xxFF' is '50FF', for example, the instruction should obtain the address to jump to from 50FF and 5100. In fact, the 6502 chip uses the values in 50FF and 5000 to form an incorrect address combination.

Assemblers are used widely by programmers who need detailed control over the operation of the computer because the application they are working on is time critical or because they need to control sophisticated peripheral devices.

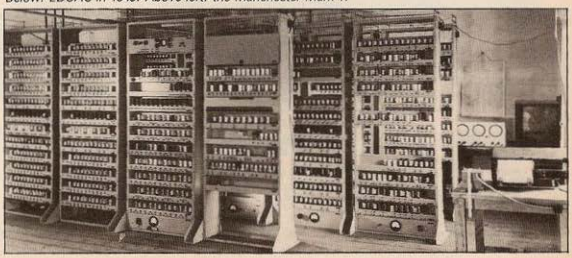
Forth was written by Charles Moore over a period of several years, although the language is dated formally as originating in 1969. Working at the National Radio Astronomy Observatory, Charles Moore wanted a new high level language to allow easy communication between the observatory instruments, the computer and the astronomer, the computer user. The IBM 1130 machine used in the observatory was a third generation computer and Charles Moore was so impressed with the results of his work that he called it a fourth generation language. The IBM 1130 permitted only five-character identifiers and

Figure 1.

6502 CPU Instruction	Binary representation
Decrement Register X	1100 1010
Load Accumulator with Zero	1010 1001 0000 0000
Load Accumulator with 1	1010 1001 0000 0001
Load Accumulator with the contents of Address 1000 Hex.	1010 1101 0000 0000 0000 0001
Jump to Subroutine at 4040 Hex.	0010 0000 0000 0100 0000 0100

Expressed in hexadecimal notation the long strings of ones and zeros become more easily manageable — the instruction to decrement register X is expressed simply as CA.

Below: EDSAC in 1949. Above left: the Manchester Mark 1.



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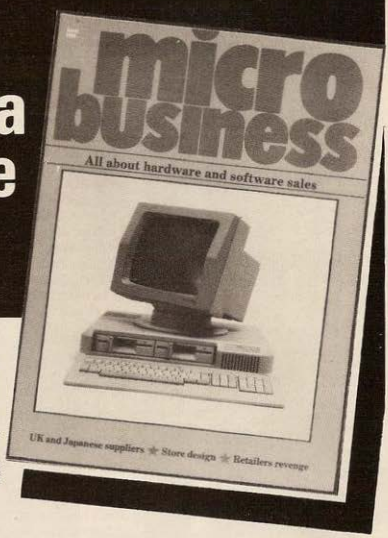

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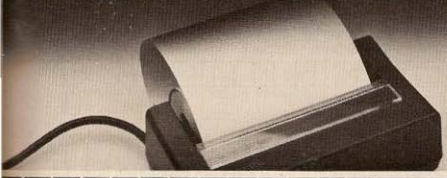

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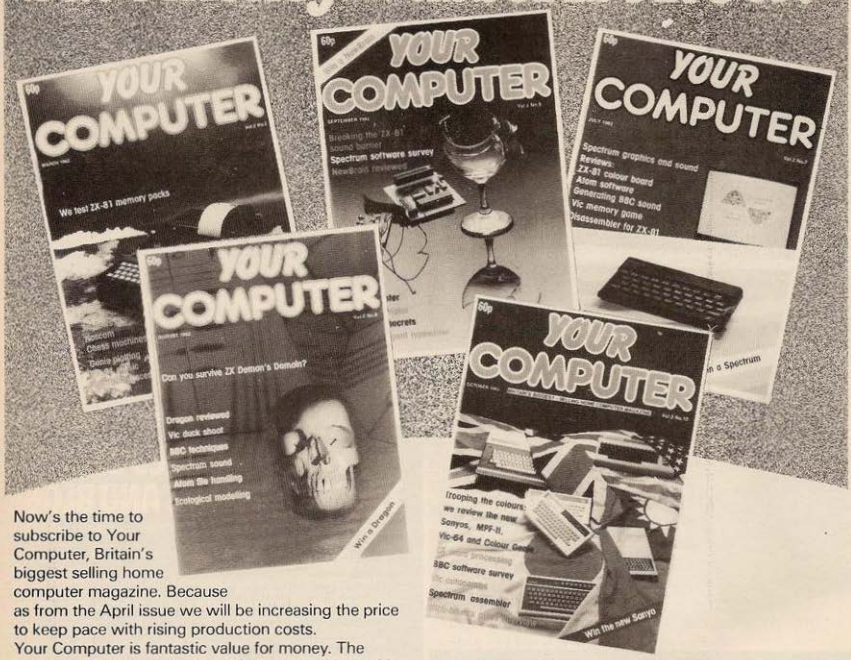

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BASIC DICTIONARY

This dictionary, compiled by Tony Edwards, will explain the function of common Basic words as used in popular machines, enabling you to work out your own machine's equivalent. A useful complement to our recent series on Basic dialect translation.

TAN The function which returns the tangent of its argument. The argument is usually expressed in radians. A standard ANSI word.

TEXT The Apple II command or statement which changes from graphics mode to text mode.

THE The PDP-8E abbreviation for THEN.

THEN Part of the IF . . . . THEN statement which is used to indicate the next operation scheduled, once the IF condition is satisfied. A standard ANSI word.

TI The Commodore Pet abbreviation for TIME.

TIM Another common abbreviation for TIME.

TIME A command and function used to return the elapsed time in seconds from some reference point. Not to be confused with TIME$.

TIME$ A function which returns the actual time of day. Not to be confused with TIME.

**TI$** The Commodore Pet abbreviation for TIME$.

TO Part of the FOR . . . TO . . .STEP statement.

TOP A function used in BBC Micro Basic to return the address of the first free location after the end of the current program.

TRACE An Apple II command or statement which causes the computer to print out line numbers as each one is executed. It is normally used during debugging only.

TRACE OFF The command or statement which switches off the TRACE Command. See also NOTRACE.

TRACE ON A command or statement similar to TRACE.

TROFF A common abbreviation for TRACE OFF.

TRON A common abbreviation for TRACE ON.

TRUE A special function used on the BBC Micro which returns the logical true value (-1) when called.

U

USR A function which transfers control from a Basic program to a machine-code program resident elsewhere in the memory.

UNTIL Part of the REPEAT . . . . . UNTIL statement.

V

VAL A function which returns the numerical value of a number expressed as a string.

VLIN AT An Apple II statement which draws a vertical line at the specified column position. The arguments after VLIN designate the start and end points and the argument after the AT designates the column.

VPOS A function which returns the vertical position of the cursor. The screen top is numbered 0.

VTAB An Apple II command which specifies the line on which the next output will commence.

W

WAIT A command or statement which causes the computer to halt execution for a specified period of time.

WIDTH A command or statement used to pre-select the printer carriage or VDU screen width.

WRITE The Apple II command or statement used to output on to disc or cassette storage material.

Non-alphanumeric characters

As well as the use of reserved words, computers also use non-alphanumeric characters as operators or abbreviations. To conclude this dictionary these are listed — in no particular order.

" (quotes). The almost universal use of quotes is to delimit the range of a string. It is an ANSI standard operator. The Atom uses a single quote for this purpose.

, (comma) An ANSI standard operator used as a delimiter in lists. The TRS-80 uses it as an abbreviation for THEN and to separate otherwise ambiguous lists. Palo Alto Tiny Basic uses the comma to allow the placing of more than one statement on a line.

. (full stop) An operator used by the TRS-80 level.1 to identify abbreviated commands, statements and functions. It can be used in level 2 as the argument of a List or Edit command and in this case means "last line operated upon". It is also used as the decimal point.

; (semicolon) A standard ANSI operator which allows several output sections to be joined together on one line.

(. . .) (parenthesis) The operator used to determine the order in which operations are performed. The innermost pair of parentheses are performed first.

[. . .] (square brackets) In many computers square brackets are interchangeable with parenthesis. The BBC Micro uses square brackets as delimiters for assembler statements. A single left square bracket sometimes represents the exponentiation operator.

= (equals) The ANSI standard mathematical equal sign. It is also widely used as an assignment operator, sometimes with a preceding LET. Most computers also use it as a relational operator to compare numerical values or strings.

^ (caret) The standard ANSI symbol for the exponentiation operator.

↑ (up arrow) Another symbol sometimes used as the exponentiation sign.

< (less than) The standard ANSI symbol for "less than". Used when comparing to numeric values. Many computers can use this to compare strings and, in this case, each character in turn is compared from the left to assess alphabetic order. As each character is compared individually and the order is decided by the first non-identical character, the length of the string is not a factor. Can be used with a "+" to represent equal to or more than.

> (greater than) The standard ANSI symbol for "greater than". Used when comparing numerical values or strings. Can be used with a "=" to represent equal to or more than.

<> (not equal to) The standard ANSI symbol for "not equal to". Used when comparing numerical values or strings.

>< (not equal to) A symbol sometimes used instead of <>.

≤ (equal to or less than) An alternative to <= used on some computers.

≥ (equal to or greater than) An alternative to >= used on some computers.

≠ (not equal to) An alternative to <> used on some computers.

' (apostrophe) used on many computers as an abbreviation for REM. Used on the Atom to enclose strings and on the BBC Micro to produce new lines in PRINT or INPUT statements. Sometimes called a "single quote". ■

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BLANK STARE

■I cannot get my Spectrum to recognise the difference between a blank space — either as CHR$ 20, 1, 32 or CHR$ 143 — and an unprinted character. The Screen$ function treats them all as 32. If an Ink is specified beforehand, then I can differentiate between them using Attr. However, if I just print up an Inv Video or G-shift t-8 black square, Attr treats it as if it were blank. What can I do?

Julian Vincent,
Earley, Reading.

IT IS UNFORTUNATE that it is impossible to detect user-graphics or blanks with Screen$. It seems an oversight when designing the ROM, as it is probable that Screen$ would find its widest application in moving graphics programs when you need to detect whether two objects have run into each other or have, say, run off the edge of a track or road. I get around the problem by using something other than a blank, which still prints up as a satisfactory object. You will find that the capital X very well for walls and things that you otherwise would print as a series of inverse spaces. Use Inverse 1 in the line that is printing the Xs, and detect them just looking for the X. The full stop can also be used, or the slash. Experiment with the letters of the alphabet and the symbols, to find one which does not look too much out of place in your program.

ATOM TOOLBOX

■I have a 12K plus 12K Atom and am contemplating an expansion of its facilities. Would you advise me to buy a programmer's toolbox ROM, considering the availability of the disc pack for the Atom, or to upgrade it by inserting a BBC ROM, considering the further expansion of the BBC computer? If I choose the latter, is it possible to upgrade it further to BBC model B?

W Luk,
Oxford.

YOU DO NOT explain the main purposes for which your computer is used, and this has some bearing on the answer to your question. The "BBC upgrade" does not turn an Atom into a BBC Micro, but simply gives it access to a large part of BBC Basic, but not at the same speed as the BBC Micro. If you are sufficiently advanced in programming the Atom to contemplate purchasing a utility ROM such as you describe, it is likely that you would be best advised to stick with the Atom, and continue to develop your skills on that, rather than convert it to a machine which is neither one computer nor the other, and have to relearn many of the techniques you have acquired to date.

PLUG BUG

■I am 12 years old and own a 1K ZX-81 which works perfectly, except sometimes when first switched on. I have found that I can correct its odd behaviour by fiddling with the power input plug to the computer. Can you tell me what is wrong?

Michael Rabbett,
Huntingdon.

THE SOCKET for the power supply — and indeed for Mic and Ear as well — tends to work loose, as you move the plugs in and out a lot. The answer is simple. Get an electrician, or a friend who knows how to do such things, to bend the metal inside the plug socket slightly, so it grips the plug firmly. As a general rule, you should not remove the plugs more than you have to. I suggest leaving them in place all the time, to minimise wear on the sockets.

SLEEP NO MORE

■I won a ZX-81 and have recently been writing a games program which involved, in part, negotiating a two-dimensional maze. The maze is randomly generated, with its only record being in the display file. By using the common

```
PEEK(PEEK 16398 +
256*PEEK 16399)
```

I thought that I could prevent the Inkey$ operated figure 1 from passing through — and erasing — the walls, which are made up from graphic spaces. For a while, I thought this had been successful, then discovered that by rapidly pressing and releasing the controlling key it was possible to pass through the wall with ease. I have tried in vain to solve the problem but it seems to be beyond me. The above is the only Peek routine I know. It works perfectly if I just want the program to stop when a wall is hit. All progress on what I hoped would be one of my best games has been halted because of this bug. I am desperate and without sleep. Can you help?

Marcus Harvey,
Chipping Sodbury.

YOUR PEEK routine is correct. The most likely explanation for its failure under certain circumstances is that you are not checking the result of this Peek every time you cycle through the program, because there are two routes through it. Perhaps you are jumping some of it when the Inkey$ is not one of the vital readings, and one of the routes misses the routine. Check this by including it in another part of the program, and make sure the line which is needed as well — the Print At ending with a semicolon — is *always* immediately before the Peek/Peek.

CHEAP MEMORY

■I would like to expand the memory of my Vic-20, but it is very expensive. Commodore charges over £70 for its unit. While looking through a recent edition of *Your Computer* I saw an advert for a 16K unit for the Vic-20 for less than £40. Does this unit do the same job as Commodore's unit? Are there any catches in buying the cheap memory?

Ricky Pedelty,
Sheppy.

I BOUGHT ONE of the cheaper memory units in August last year, and was unable to get it to work. I returned it, and asked to see the replacement working before I accepted it. I was happy with the demonstration in the shop, and since then, have had no problems with the unit at all. There is no indication, in terms of performance, that the cheaper memory is not doing everything the Commodore unit would provide. I suggest the dud unit I got the first time was just luck of the draw. Perhaps I would have been just as unfortunate with a Commodore expansion.

PICK A MICRO

■Please help! I often read your magazine, which I find fascinating, particularly the evaluations of micros. However, there now seems to be a bewildering range of micros available. I should be very grateful for any advice on the most appropriate one for my own needs, which are at least 32K of memory, expandable; high-resolution colour graphics, with the possibility of 3-D graphics; scientific use — I am not particularly interested in games; real typewriter keyboard; ability to turn a cassette player on and off from the computer; usable with UHF TV; a good, clear user manual; good colour; and under £400.

S J Pearson,
Leeds.

IT SOUND as if you are talking about the BBC Micro model B. Check out the Electron before you make your final decision. The highest graphics resolution on the model B demands a monitor to see the graphics at their best, and would be vital for any 3-D graphics work.

MAKING A DIN

■I have just ordered a 48K Spectrum. The tape recorder I wish to use is a Philips EL-3302 which has DIN input/output sockets. As the Spectrum is only supplied with jackplug leads, I would like some information on how to connect up the Sinclair leads to DIN leads.

A R Smith,
Torquay.

IT IS LIKELY that you will not be able to make the conversion satisfactorily. The Spectrum demands a high output from the cassette recorder, such as that which would be used to power an external speaker, rather than the reduced output for headphones. Secondly, the output from the Spectrum when Saving is designed for a socket with the sensitivity of an ordinary microphone socket. Speak to an electrician about tapping into the extension speaker output, and getting into the microphone, rather than ancillary, input.

LOWLAND SCROLL

■I recently received a 16K Spectrum and am still discovering new possibilities. My only question so far is about Poke 23692 which — according to the manual — will let the screen roll on and on. I have tried this, but it does not work on my machine. Do other Spectrum owners have problems with this?

B R Smit,
Maarssen,
The Netherlands.

THIS POKE is designed to stop the Spectrum printing up Scroll? everytime the screen is full, and needs to be positioned within the program in such a way that it is triggered fairly regularly. I usually use it within the master loop of a program. If you still get Scroll? from time to time, scatter the line throughout the program a few more times. The form I use is Poke 23692, -1.

DRAGON LORE

■I have recently bought a Dragon 32 computer and would like to know if you could recommend a book on programming in extended Basic. Also, could you tell me which other computer software is compatible with the Dragon?

Mrs J Begg,
Abergavenny,
Gwent.

It is rare that Tandy Colour Computer programs will run on the Dragon 32 even in cassette form. About the only way to convert Tandy software for the Dragon is to get someone with a Tandy to

```
CSAVE PROGRAM NAME "A"
```

This will save your Tandy program in ASCII form. Then you will be able to load it into the Dragon. If it is in machine-code you will not be able to run it at all. ■

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FINGERTIPS

Fingertips is our regular calculator column covering calculator news, programming hints and examples of unusual applications. The column is written and compiled by calculator enthusiast David Pringle who is glad to hear of any of your ideas. *Your Computer* pays £6 for each of your contributions published.

THIS MONTH I risk the invective of readers who tell me the Sharp PC-1211 should not feature in this column. "It's not a real pocket calculator", they say. Well, here goes anyway with a program called Treasure Quest by J V Moss of London.

Fantasy games are increasing in popularity, and also variety, but it may surprise some people that it is possible to run such a game on as small a machine as the Sharp PC-1211 Pocket Computer.

In the game to be described, the player travels through a labyrinth of caves, the object being to find the treasure and bring it out of the caves within forty days.

The labyrinth is represented by a seven-by-seven square matrix of 49 caves. The caves may be empty, or they may be inhabited by fairies, trolls, giants or dragons. The player may move through the labyrinth cave by cave, using the commands N, S, E or W, representing the points of the compass. Alternatively he may rest or fight.

Initially, the player is in the most south-westerly cave, and he knows only that the treasure lies in a cave to the far north-east. On finding the treasure, he must bring it out by the most north-easterly cave.

The computer keeps a record of the days — it takes one day to journey from one cave to the next — and tells you what, if anything, inhabits the cave.

Trolls, giants and dragons are the adversaries, in order of danger, trolls being the least dangerous. The player can decide there and then to fight, which gives him the advantage in the conflict. Alternatively, the player may try to move to another cave, to return the way he came, or to rest quietly for a day. If the adversary sees him, then he will fight, and in this case the opponent has the advantage. The adversary is less likely to see you if you rest, or return the way you came.

The outcome of a fight is determined using random numbers. Fighting uses up energy — as does moving about — which can be recovered by resting. If you are injured, it is best to rest in a fairy cave, and let the fairies attend to your injuries. However, the quest must be completed within forty days.

The program uses all the available memory of the PC-1211. Therefore there are no comments, and the program must be keyed in exactly as written.

The subroutine at line 2 is a random number generator which generates a positive integer in F less than the initial value of F, using a fractional seed in E. It was positioned here because there was thought to be a speed advantage in executing a subroutine at the beginning rather than the end of the program area.

Line 100 fills the matrix with creatures for the new game. Line 110 sets up the initial values including the position of the treasure. Line 200 checks if the treasure has been brought to the north-eastern most cave. If not, lines 201 to 226 display the current situation and line 228 invites a response.

Lines 230 to 255 process the response, checking directions to ensure that the player can only move within the matrix. Line 260 checks for moving back the way you came, to alter the value of F so there is less chance of an adversary seeing you. Line 275 actions the move.

Lines 300 and 340 are concerned with "resting", and lines 350 and 360 determine whether you are spotted by an adversary. Lines 400 to 445 determine the result of a fight. lines 600 to 800 are self-explanatory.

The program could easily be adapted to run on other computers using other dialects of Basic. On the PC-1211, Beep merely sounds a buzzer, Pause displays a line for about half-a-second before going to the next line.

Variable memory is handled in a slightly strange way, in that each of the first twenty-six variables, A to Z, may be referenced in four different ways. Thus A, A$, A(1) and A$(1) all refer to the first variable, B, B$, A(2) to the second, and so on. The use of variables is listed in table 1.

In playing the game, it will be found helpful if a seven-by-seven grid is drawn, and the inhabitant of each cave marked as it is visited, in case it is wished to return to, or avoid, a particular cave. It is quite difficult to complete the quest in 40 days. Happy hunting.

Adventure game for PC-1211.

```
1    A(64)=0:GOTO 100
2    E=EXP(LN( E +  )*5): E=E-INT(E):F=INT(E*F):RETURN
100  FOR I=14 TO 62: F=5: GOSUB 2: A(I)=F:NEXT I
110  L=0: M=0: K=14: G=25: F=3: GOSUB 2:H=F:F=3:GOSUB 2:
     A(48) = F*7 -H) > 6
200  IF K = 56 IF A(64) > 0 THEN 700
201  H=A(K):IF H=6 THEN 600
202  IF H=0 BEEP 1: PAUSE"EMPTY CAVE":GOTO 225
220  BEEP 1:PAUSE"CAVE CONTAINS A ",A$(H)
225  M = M + 1: PAUSE"DAY":M:IF M= 40 PAUSE"YOUR TIME IS UP":
     STOP
226  IF K < 6 PAUSE"YOU ARE TIRED"
228  INPUT"WHAT DO YOU DO?",J$
230  IF J$ = "FIGHT" THEN 400
235  IF J$ = "REST" LET F = 3:GOTO 300
240  I = 0: IF J$ = "N" LET I = 7
241  IF J$ = "S" LET I = -7
242  IF J$ = "W" LET I = -1: IF K-INT(K/7)*7=0 THEN 290
243  IF J$ = "E" LET I = 1: IF  K-INT(K/7)*7=6 THEN 290
245  IF I = 0 GOTO 228
250  IF K+I<14 THEN 290
255  IF K+I>62 THEN 290
260  G = G -I: IF I = -L LET F = 3:GOTO 270
265  F = 6
270  IF H > 1 THEN 350
275  L = I:K = K + I:GOTO 200
290  BEEP 2: PAUSE"NO EXIT TO ",J$: GOTO 228
300  G = G + 2 IF H = 0 THEN 225
305  I = 0:IF H > 1 THEN 350
310  F = 12: GOSUB 2
320  IF F < 11 IF G < 16 PAUSE"FAIRY TENDS YOUR WOUNDS":
     G = G + 8:GOTO 225
330  IF F = 11 PAUSE"FAIRY GIVES YOU":PAUSE"A MAGIC SWORD":
     G = G + 10
340  GOTO 225
350  GOSUB 2:IF F < 2 THEN 275
360  BEEP 3: PAUSE"HE SEES YOU":PAUSE"YOU MUST FIGHT":
     I = 4:GOTO 410
400  I = 0:IF H = 0 THEN 225
410  F = 2: GOSUB 2
415  IF EXP(LN(H*(F+1)))+I>G THEN 800
420  G=G-H*2
430  BEEP 4:PAUSE "YOU KILLED THE ",A$(H): A(K)=0: H=0
435  IF G>15 THEN 220
440  J$="":IF G<8 LET J$="BADLY "
445  PAUSE "BUT YOU ARE ",J$;"INJURED":GOTO 228
600  BEEP 5:PAUSE "YOU FOUND THE TREASURE!":A(K)=0:H = 0:
     A(64) = 1: GOTO 220
700  BEEP 8:PAUSE "TASK DONE IN ",M;" DAYS"
710  PRINT"YOU MARKY THE PRINCESS!":STOP
800  BEEP 5:PRINT"YOU ARE KILLED!"

1107 STEPS
```

Word processor for Sharp PC-1500.

```
10:"A":WAIT 0:
   CLEAR :DIM T$(
   120)*79:L=1
20:"C":INPUT T$(L
   ):LPRINT T$(L)
   ;:CSIZE 1:
   LPRINT L:CSIZE
   2:L=L+1:LF 1
30:IF L<121THEN 2
   0
40:"B":L=L-1:D=L:
   LF 2
50:A=1:E=D:D=INT
   (D*.73+.5):
   PRINT STR$ E
60:FOR B=1+DTO L
70:G$=LEFT$ (T$(A
   ),16):H$=LEFT$
   (T$(B),16)
80:IF G$>H$THEN 1
   00
90:GOTO 110
100:T$(0)=T$(A):T$
    (A)=T$(B):T$(B
    )=T$(0)
110:A=A+1:NEXT B
120:IF D<>ETHEN 50
130:"D":CLS :GRAPH
    :ROTATE 1:J=1
140:GLCURSOR (0,-9
    9):SORGN
150:FOR M=1TO 61
    STEP 20
160:FOR K=1TO 12
170:GLCURSOR
    K*18,0):LPRINT
    MID$ (T$(J),M,
    20):J=J+1:NEXT
    K
180:GLCURSOR (0,-2
    40):SORGN :J=J
    -12:NEXT M
190:J=J+12:IF J<=L
    THEN 140
200:TEXT :END
```

```
Priority order of characters:-
space
! # $ % & ( ) * + , - . /
0 1 2 3 4 5 6 7 8 9
: ; < = > ? @
A B C ... X Y Z
[ \ ] ↑ ← A
a b c ... x y z
```

Table 1: memory utilisation.

A$(1) — A$(4) are set up before running. E and F are used by random number generator.

A$(1) = "FAIRY"
A$(2) = "TROLL"
A$(3) = "GIANT"
A$(4) = "DRAGON"
E = decimal fraction
F
G = energy of player
H = strength of adversary
I = working variable
J$ = interactive response
K = co-ordinate within matrix
L = previous response
M = count of days
A(14) — A(62) = matrix
A(64) = treasure found indicator.

The second program by A E Cox of Sussex, is a very interesting indexing program written for the Sharp 1500. It can sort up to 120 character strings of 79 characters each into alphabetical order and then prints them out as shown. Could it be the first genuine useful word-processing program for a pocket-sized calculator?

Each item is printed immediately after it is entered, taking up to about 4.5 lines of print. The items are then sorted out into alphabetical order — ASCII priority — and printed out lengthwise in blocks of 12 items.

The user should first check that there is adequate paper and Text mode is Csize 2. Now press Def A. Next, write first item and Enter. Write each subsequent item in the same way. To sort, press Def B. Print-out follows automatically.

To amend items, note the tally number at the end of the item to be amended. Press Break. Write L=n — tally number and Entry. Press Def C. Write the new text and Enter, then press Break. Write L=m, where m=1 + last tally number on the print-out. Enter. Press Def C; continue.

Items already entered may be printed out lengthwise without sorting, by pressing Def D. ■

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WHAT THE PRESS SAY ABOUT IT:—

IF YOU have always wanted to manage a football team, FOOTBALL MANAGER, from Addictive Games, is for you — The game is ideal for a football fanatic but the most interesting thing for us was the 3-D graphics used to create the goalmouth action — the game is a winner.
SINCLAIR USER FEBRUARY 1983

Although I'm no great football fan, I really enjoyed playing this game — excellent use is made of colour and user-defined graphics. The game is very logically put together, so that the development of strategy and tactics has a real effect. For example, one of my teams got through to the fourth round of the F.A. Cup where it was beaten by a second division side. This upset morale and meant that our promotion bid failed. Perhaps I should have given up the F.A. Cup run and held some good players back — the possibilities are endless. Brian Clough had better watch out!
ZX COMPUTING FEB/MARCH 1983

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Figure 1.

Address	Hexadecimal
16514	2A 0E 40
	06 11 36
	05 0E 21
16523	2B 0D 20
	FC 5E 1C
	1D 20 22
	36 05 0E
16535	21 23 0D
	20 FC 36
	00 0E 21
16544	2B 0D 20
	FC 0E FE
	0D 20 FD
16553	0E FE 0D
	20 FD 10
	D7 36 00
	01 00 00
16565	C9 2B 2B
	2B 0E 05
	23 36 00
16574	0D 20 FA
	0E 1F 23
	0D 20 FC
	36 00 01
	0C 08 C9

Figure 2.

```
1   Rem [75 Xs]
10  Let A$=" "
20  For X=16514 To 16588
30  If A$=" " Then Input A$
40  Poke X,16×Code A$+Code A$(2)-476
50  Scroll
60  Print X,"(3spaces)"; A$(To 2)
70  Let A$=A$(3 To)
80  Next X
```

Figure 3.

```
1   Rem [machine code]
5   Let score=0
10  Print At 4,6;"⊠⊠⊠"
20  Let A=10
30  Let L=0
40  Let A=A+(Inkey$="8" And A<29)-
    (Inkey$="5" And A>2)
50  Print At 19,A-2;"□◪▣□"; At 18,A;
60  If Inkey$="0" Then Let L=Usr 16514
70  If L<>0 Then Let score=score+1
80  Goto 30
```

Search and destroy

C Stewart,
South Shields,
Tyne and Wear.

ZX-81

THIS SHORT machine-code routine produces a missile on line 18 on the display. It proceeds upwards searching for an alien as it goes. The missile leaves the display if no obstruction is found, or blots it out if an obstruction is found. The machine code is stored in a Rem in line 1 containing 75 bytes. After entering:

```
1 REM (75 Xs)
```

enter the hex loader in figure 2. Run the program in the fast mode and enter the codes given in figure 1. They can be entered individually — 2A Newline 0E Newline — or in batches of as many as you like — 2A 0E 40 06 Newline. To operate the routine the print position must be set to:

```
PRINT AT 18, A;
```

immediately before calling the routine, where A is the column you wish the missile to appear in. To increase speed, Poke 16549 — less than 255 — and for the missile character, Poke 16520 — code character — and Poke 16533 — code character.

Input the program in figure 3, which demonstrates the routine. Run the program and move using the 5 and 8 keys. Try missing the alien and then hitting it. Line 70 keeps the score and line 30 must be within the main loop. Line 0 on the display is left untouched by the missile for scores and titles, however more can be left by Poke 16518. The routine is ideal for invader-type games.

Space chase

Tahir Abbas,
Edinburgh.

SPECTRUM

IN THIS GAME for the 48K Spectrum, you shoot down 10 alien craft before they reach the safe zone. You are looking out of your cockpit window and have to line them up in your sights and fire your lasers. If they reach the safe zone then you have failed. The bottom of the screen displays time left and craft shot down.

To fly your ship use these keys:

Up	7
Down	6
Left	5
Right	8
Fire	0

This program uses three machine-code routines. The first of these copies the screen into another part of the memory. It acts as a kind of CLS but it recalls the saved screen only, clearing everything else on the screen.

Space Chase program construction.

```
10 TO 195--SCREEN CONSTRUCTION.
200 TO 202--LOAD DATA FOR SOUND
            AND SCREEN ROUTINES.
300 TO 305--VARIABLES.
500 TO 560--PRINT ALIEN CRAFT
            & MOVEMENT OF YOUR
            CRAFT.
605 TO 700--FIRE LASER.
800 TO 860--EXPLOSION & SOUNDS.
905 TO 980--PRINT STARS.
1000 TO 9020--END OF GAME
              ROUTINE & DATA.
```

Space Chase graphics.

```
▚▚----ABCD   LINES 505 & 605
:----E.  CHR$ 148
•----F.  LINE 965
●----G.  LINE 967
```

Register HL holds the location where the copy starts. Register DE holds location where screen is moved to. Register BC holds the amount of bytes to be transferred. LDir carries out the task of moving the block of memory.

The next machine-code routine enhances the Spectrum's sounds. It uses the Spectrum's sound routine in the ROM. Register DE holds duration of the note; register HL holds pitch of the note; and register B controls the loop.

The final machine-code routine prints out the explosion. The data for the explosion is held in location 40051 onwards. All the machine-code routines are held in Data statements within the program. So there is no need to load them separately in the Spectrum. The sound routine used in this program was developed from the sound routine printed in November's *Your Computer*.

Once you have mastered the game as it stands, you can make it more difficult by reducing the time variable "ti" in line 300.

```
  1 REM *****SPACE CHASE*****
  2 REM WRITTEN BY TAHIR ABBAS.
  3 REM          FOR THE
            48K SPECTRUM.
  5 REM SCREEN CONSTRUCTION.
 10 REM
 11 INVERSE 0: OVER 0: BRIGHT 0
: BORDER 3: PAPER 0: INK 9: CLS
 20 INK 6: PLOT 112,64: DRAW 0,
15,-PI: DRAW 15,0: DRAW 0,15: DR
AW 1,0: DRAW 0,-15: DRAW 15,0: D
RAW 0,-15,-PI: DRAW -15,0
 30 DRAW 0,-15: DRAW -1,0: DRAW
 0,15: DRAW -15,0
 40 PLOT 105,92: DRAW -15,0: DR
AW 0,-1: DRAW 15,0: PLOT 151,92:
 DRAW 15,0: DRAW 0,-1: DRAW -15,
0
 50 INK 7
 70 PLOT 30,0: DRAW 15,15: DRAW
 1,0: DRAW 5,5: DRAW 1,0: DRAW -
5,-5: DRAW 1,0
 80 DRAW -5,-5: DRAW 20,-10
 90 PLOT 225,0: DRAW -15,15: DR
AW -1,0: DRAW -5,5: DRAW -1,0: D
RAW 5,-5: DRAW -1,0: DRAW 5,-5
 100 DRAW -20,-10
 105 REM
 106 REM COPY SCREEN
 110 FOR f=40000 TO 40050: READ
a: POKE f,a: NEXT f
 120 DATA 33,0,64,17,80,195,1,19
2,26,237,176,201,33,80,195,17,0,
64,1,192,26,237,176,201,0,0,17,1
0,0,33,10,0,6,10,197,213,229,205
```

(continued on page 135)

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(continued from page 133)

```
,181,3,1,100,0,225,237,74,209,19
3,16,240,201
 130 PRINT INK 4;AT 21,10;"TIME=
"
 140 PLOT 75,0: DRAW 0,9: DRAW 7
6,0: DRAW 0,-9: PLOT 170,0: DRAW
 0,9: DRAW -18,0
 195 LET l=USR 40000
 196 RESTORE 8600
 197 REM
 198 REM USR GRAPHICS
 200 FOR g=144 TO 150: FOR f=0 T
O 7: READ a: POKE USR CHR$ g+f,a
: NEXT f: NEXT g
 202 FOR f=40051 TO 40169: READ
a: POKE f,a: NEXT f
 210 POKE 40027,10: POKE 40033,1
0: POKE 40041,100
 230 LET l=USR 40012: PAUSE 30
 300 LET ti=500: LET sh=10
 305 LET x=INT (RND*15): LET y=I
NT (RND*27)
 310 GO SUB 500
 330 GO TO 900
 500 PRINT AT x,y;"◆◆◆◆"
 505 PRINT AT 21,15;ti: LET ti=t
i-1
 510 LET x=x+INT (RND*3)-1+(INKE
Y$="7")-(INKEY$="6")
 520 LET x=x+2*((x<0)-(x>16))
 530 LET y=y+INT (RND*3)-1+(INKE
Y$="5")-(INKEY$="8")
 540 LET y=y+2*((y<0)-(y>28))
 550 LET l=USR 40012
 560 RETURN
 600 REM
 605 PRINT AT x,y;"◆◆◆◆"
 610 INK 3: PLOT 54,22: DRAW 72,
67: PLOT 201,22: DRAW -72,67: LE
T l=USR 40026: INK 7
 620 IF POINT (128,90)=1 THEN GO
TO 800
 650 GO SUB 500
 700 RETURN
 800 REM
 801 LET l=USR 40012
 803 PRINT AT 21,15;ti
 804 POKE 40027,5: POKE 40033,20
: POKE 40041,30
 805 FOR f=1 TO 2: LET l=USR 400
26: POKE 40033,60: NEXT f
 806 PRINT AT 0,0;
 810 POKE 40027,1: POKE 40033,1:
POKE 40041,0: POKE 40159,0
 815 POKE 40150:INT (RND*2)+148
 820 PRINT : LET L=USR 40135
 825 POKE 40150,32
 830 POKE 40027,1: POKE 40033,1:
POKE 40041,0: POKE 40159,12
 832 PRINT : LET L=USR 40135
 834 LET L=USR 40012
 835 POKE 40027,10: POKE 40033,5
: POKE 40041,250: FOR f=1 TO 10:
 LET l=USR 40026: NEXT f
 845 POKE 40027,10: POKE 40033,1
0: POKE 40041,100
 850 LET sh=sh-1: PRINT AT 21,20
;sh: IF sh=0 THEN GO TO 2400
 860 FOR F=1 TO 20: NEXT F: GO T
O 305
 905 LET y=INT (RND*4)+1
 910 IF ti<23 THEN GO TO 1000
 920 RESTORE 7000+v
 930 LET a$="."
 940 FOR f=1 TO 6
 950 GO SUB 500
 960 READ j,k
 965 IF j<8 OR j>11 THEN LET a$=
"●"
 967 IF j<4 OR j>15 THEN LET a$=
"●"
 970 PRINT BRIGHT 1;AT j,k;a$
 975 IF INKEY$="0" THEN GO SUB 6
00
 980 NEXT f
 990 GO TO 905
1000 LET z=85: LET g=85: LET l1=
85: LET l2=5
1010 PLOT z,g: DRAW l1,0: DRAW 0
,l2: DRAW -l1,0: DRAW 0,-l2
1020 GO SUB 500
1030 LET z=z-5: LET g=g-5: LET l
1=l1+10: LET l2=l2+10: IF z=0 TH
EN GO TO 2000
1050 GO TO 1010
2000 POKE 40027,10: POKE 40033,1
0: POKE 40041,100: LET l=USR 400
12: FOR f=1 TO 20: LET l=USR 400
26: NEXT f: FOR f=1 TO 100: NEXT
 f: CLS
2005 LET TI=0
2010 BORDER 2: PAPER 3: INK 9: C
LS: PRINT : PRINT "YOU
HAVE FAILED IN YOUR MISSION.";'';
sh;" ENEMY CRAFTS REACHED THE SA
FE";''"ZONE."
2015 GO SUB 2700
2020 INPUT "DO YOU WISH TO PLAY
AGAIN ?      (y/n)";a$
2030 IF a$="y" OR a$="Y" THEN BO
RDER 3: PAPER 0: INK 9: CLS : PA
USE 50: RUN 205
2040 PRINT ''"THANK YOU FOR PLAY
ING.": STOP
2410 POKE 40027,5: POKE 40033,20
: POKE 40041,200: LET L=USR 4001
2
2420 FOR F=1 TO 5: LET L=USR 400
26: NEXT F
2500 PAUSE 100: INK 1: BORDER 4:
 PAPER 6: CLS : PRINT AT 0,0;"WE
LL DONE";''"YOU HAVE COMPLETED YO
UR MISSION SUCCESSFULLY."
2510 PRINT ''"ALL 10 ENEMY CRAFT
 ARE DESTROYED"
2520 GO SUB 2700
2600 GO TO 2020
2700 PRINT ''"YOUR SCORE IS ";TI
*10+((10-SH)*10): RETURN
7001 DATA 10,15,9,14,8,13,7,11,4
,6,0,0
7002 DATA 10,16,9,17,8,18,7,20,4
,25,0,31
7003 DATA 10,15,11,14,12,13,13,1
1,16,5,21,0
7004 DATA 10,16,11,17,12,18,13,2
0,16,25,21,31
8600 DATA 0,24,60,63,63,63,60,24
,17,35,71,141,255,255,127,9,136,
196,226,177,255,255,254,144,0,24
,60,252,252,252,60,24
8620 DATA 0,BIN 10000000,0,BIN 0
0000010,0,BIN 01000000,0,BIN 000
01000
8630 DATA 0,0,56,124,124,124,56,
0,56,126,255,255,255,255,126,60
9000 DATA 10,15,10,16,8,17,12,14
,12,17,6,14,12,16,8,13,8,16,12,1
3,9,12,11,19,11,12,9,19,7,13,13,
18,7,18,13,13,13,12,7,19,13,19,7
,12,6,14,14,17,6,17,14,14,12,11,
8,20
9010 DATA 8,11,12,20,14,15,6,16,
14,15,8,15,9,21,11,10,11,21,9,10
,10,22,10,9,15,16,5,16
9020 DATA 33,115,156,6,42,62,22,
215,126,215,35,126,215,35,62,32,
215,197,229,205,90,156,33,232,4,
43,124,181,32,251,225,193,16,227
,201
```

Screen copy.

```
40000 LD    HL,16384
40003 LD    DE,50000
40006 LD    BC,6335
40009 LDIR
40011 RET
40012 LD    HL,50000
40015 LD    DE,16384
40018 LD    BC,6335
40021 LDIR
40023 RET
```

Sound enhancer.

```
40026 LD    DE,5
40029 LD    HL,10
40032 LD    B,40
40034 PUSH  BC
40035 PUSH  DE
40036 PUSH  HL
40037 CALL  949
40040 LD    BC,200
40043 POP   HL
40044 ADC   HL,BC
40046 POP   DE
40047 POP   BC
40048 DJNZ  40034
40050 RET
```

Dream machine

Tim Goldingham,
Maidenhead,
Berkshire.

DRAGON

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It is strongly recommended that you run the program a few times without attempting to understand how it works; if possible, have a friend key it in for you.

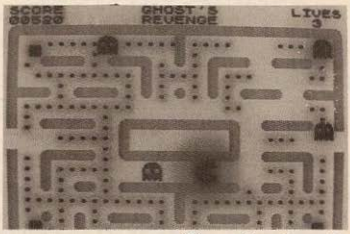
The program is based on a party game, in which one of the players who does not know the rules is sent out of the room. The other players ostensibly concoct a dream; but in fact the simple rule is that they answer "Yes" to any question ending in a vowel, while questions ending in a consonant get a "No" response. Y is treated as ambivalent.

This simple algorithm has some limitations. In practice, very few words end in vowels other than "e"; and the game is inclined to get stuck

(continued on page 137)

ZX SPECTRUM

GHOST'S REVENGE



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5 MINSTER GDNS, NEWTHORPE, EASTWOOD, NOTTS.

(continued from page 135)

if the questioner ends most of his questions with "me". The computer program overcomes these limitations by selecting five letters at random at the beginning of each run. If a question ends in any of the selected letters, it is given one of a choice of affirmative answers, picked at random. Similarly, a further three letters are selected which produce "maybe" answers. Even when you know the rules you will still find the game addictive, because you do not know what choice of letters has been made for the current run.

To increase the variety of responses, questions beginning "Had I", "Did I" are answered "Yes, you had" or "No, you didn't"; sometimes the remainder of the question is repeated, sometimes not.

Looking at the program in more detail, lines 80 to 150 produce a suitably scientific-looking "brain scan": any similar graphics pattern could be substituted, or this section omitted.

As there are some letters which very rarely end a word, line 200 lists those from which the selection will be made. Lines 210 to 280 then set up two variables, C$ and D$, containing respectively five and three letters. The Instr function is used to ensure that no letter is selected twice. Any question ending in a letter that appears in C$ will receive a "yes" answer, while the three letters in D$ will produce a "maybe".

The question is read at line 300, and stripped of its question mark by line 340. Also, line 360 removes a final "s", so that a succession of plurals does not produce the same answer. The last letter of the question is then compared with C$ and D$, by lines 380 and 390.

Responses are selected at random from the appropriate set. Lines 600-630 and 710-740 transpose pronouns and auxiliary verbs. Notice line 760, which prevents the question "Was I with my aunt?" from receiving the answer "Yes, you were with my aunt".

To introduce some variety, questions are counted by line 330, and the first "No" answer after 25 questions prompts the possibly misleading response "Haven't you forgotten something?"

If you want a recap, an asterisk will print all the questions that received the answer "yes" — lines 810-850. Finally, if you must cheat, a hash sign will show you which letters are currently being used to make the selection — line 320.

You can experiment with variations of the program by altering the letters from which the selection is made — line 200; by adding extra responses; or by altering the probability of any particular one being selected — lines 420 and 470.

```
10 'THE DREAM MACHINE
20 'COPYRIGHT T P GOLDINGHAM 1982
30 CLEAR 2000
40 DIM A$(300)
50 CLS:PRINT"THE COMPUTER WILL MONITOR YOUR  UNCONSCIOUS MIND. HOLD THE LEAD TO
 THE TELEVISION SET. AND RELAXCOMPLETELY."
60 PRINT:PRINT"PRESS THE SPACE BAR WHEN YOU AREREADY."
70 IF INKEY$(0)" " THEN 70
80 'chart
90 MODE 4:SCREEN 1,0:PCLS
100 N=4
110 FOR J=0 TO 252 STEP N
120 R=RND(96):X=J+N:Y=156-R
130 LINE(J,78)-(X,Y),PSET:SOUND R,1:LINE(X,Y)-(J+N,78),PSET
140 NEXT
150 SCREEN 0
160 'set parameters
170 CLS:PRINT"THE COMPUTER HAS NOW STORED THE DREAM YOU HAD LAST NIGHT. YOUR  C
ONSCIOUS MIND IS NOT AWARE OF  THIS! YOU HAVE TO GUESS IT BY A SERIES OF YES/NO
QUESTIONS."
180 PRINT:PRINT"PRESS THE SPACE BAR TO START."
190 IF INKEY$(0)" " THEN 190
200 A$="ABDEGHKLMNOPRTW"
210 FOR J=1 TO 5
220 B$=MID$(A$,RND(LEN(A$)),1):IF INSTR(1,C$,B$)>0 THEN 220
230 C$=C$+B$
240 NEXT J
250 FOR J=1 TO 3
260 B$=MID$(A$,RND(LEN(A$)),1):IF INSTR(1,D$,B$)>0 THEN 260
270 D$=D$+B$
280 NEXT J
290 CLS
300 LINE INPUT Z$:IF LEN(Z$)<1 THEN 300
310 IF Z$="*" THEN 810
320 IF Z$="#" THEN PRINT:PRINT"yes "C$,"maybe "D$:PRINT:PRINT:GOTO 300
330 B=B+1
340 X=ASC(RIGHT$(Z$,1)):IF X<65 THEN Z$=LEFT$(Z$,LEN(Z$)-1):GOTO 340
350 C$=Z$
360 IF X=83 THEN Z$=LEFT$(Z$,LEN(Z$)-1)
370 F$=RIGHT$(Z$,1)
380 IF INSTR(1,C$,F$)>0 THEN 450:'yes
390 IF INSTR(1,D$,F$)>0 THEN 500:'maybe
400 'no
410 R=RND(9)
420 PRINT" ";:ON R GOSUB 560,570,580,590,610,610,610,610,610
430 GOTO 300
440 'yes
450 R=RND(9)
460 A$(B)=A$(B)+F$
470 PRINT" ";:ON R GOSUB 660,670,680,690,700,710,710,710,710
480 GOTO 300
490 'maybe
500 R=RND(9)
510 IF R<4 THEN PRINT" WELL, MAYBE"
520 IF R>3 AND R<7 THEN PRINT" YOU COULD SAY THAT"
530 IF R>6 THEN PRINT" I SUPPOSE SO"
540 GOTO 300
550 'messages - no
560 PRINT"NO":IF B>25 THEN PRINT"HAVEN'T YOU FORGOTTEN SOMETHING?":B=-50:RETURN
ELSE RETURN
570 PRINT"DEFINITELY NOT":RETURN
580 PRINT"CERTAINLY NOT":RETURN
590 PRINT"NOT REALLY":RETURN
600 IF LEFT$(Z$,6)="DID I "THEN PRINT"NO. YOU DIDN'T":GOSUB 760:RETURN
610 IF LEFT$(Z$,5)="HAD I "THEN PRINT"NO. YOU HADN'T":GOSUB 760:RETURN
620 IF LEFT$(Z$,5)="WAS I "THEN PRINT"NO. YOU WERENT":GOSUB 760:RETURN
630 IF LEFT$(Z$,7)="WAS IT "THEN PRINT"NO. IT WASN'T":GOSUB 760:RETURN
640 GOTO 560
650 'messages - yes
660 PRINT"YES":RETURN
670 PRINT"THAT'S RIGHT":RETURN
680 PRINT"CORRECT":RETURN
690 PRINT"YOU RE GETTING WARMER":RETURN
700 PRINT"THAT'S IT":RETURN
710 IF LEFT$(Z$,6)="DID I "THEN PRINT"YES. YOU DID":GOSUB 760:RETURN
720 IF LEFT$(Z$,5)="HAD I "THEN PRINT"YES. YOU HAD":GOSUB 760:RETURN
730 IF LEFT$(Z$,5)="WAS I "THEN PRINT"YES. YOU WERE":GOSUB 760:RETURN
740 IF LEFT$(Z$,7)="WAS IT "THEN PRINT"YES. IT WAS":GOSUB 760:RETURN
750 GOTO 660
760 IF INSTR(1,Z$,"MY")>0 THEN PRINT MID$(Z$,6)' ELSE PRINT
770 RETURN
780 IF RND(3)>1 THEN PRINT MID$(Z$,7) ELSE PRINT
790 RETURN
800 'print summary
810 FOR J=0 TO 4
820 D$=LEFT$(A$(J),5)
830 IF D$="DID I"OR D$="HAD I"OR D$="WAS I"THEN A$(J)=MID$(A$(J),7)
840 PRINT A$(J)
850 NEXT J
860 GOTO 300
```

Option

Peter Lewis,
Widnes,
Cheshire.

VIC-20

WHEN PROGRAMMING the sound registers on the Vic, there are only two ways to cut out the sound. The first is to Restore the computer, however this also clears the screen. The other alternative is to re-Poke all the registers.

This program introduces a third option. It allows the user to control the volume of sound by using the function keys. The program is called up 60 times a second by using the IRQ routine.

It is initiated by the command SYS 673 and can be switched off by restoring the Vic.

```
5 I=673
10 READ A
20 IFA= 999 THEN END
22 POKEI,A
24 I=I+1
26 GOTO 10
30 DATA 169,173,141,20,03,169,02,141,21,03,96,234
40 DATA 32,184,02,32,205,02,76,191,234,234,234
50 DATA 165,197,201,39,240,01,96,173,14,144
60 DATA 201,00,208,01,96,206,14,144,96,234,234
70 DATA 165,197,201,47,240,01,96,173,14,144
80 DATA 201,15,208,01,96,238,14,144,96
90 DATA 999
100 REM *** SYS673 TO START ***
110 REM ***  RESTORE TO END ***
```

Lawn mower

Shingo Sugiura,
Putney,
London.

BBC

HAVING FAILED all your O-levels you could only get a job as a lawn mower, but the garden is not as calm as it seems. There are explosive cricket balls which you must not run over and rocks which will blow you up if touched. On top of this if your oil runs out, you will be vaporised.

When you first run this game you will be greeted by a short instruction. Then you are asked to input your speed, level and the loudness. After this the game starts with a short burst of music. You must guide the mower around the garden whilst avoiding the cricket balls and the rocks and gobbling up the oil cans, but this is not all. If you mow over an area already mowed, your oil will decrease but your score will stay the same. So the trick is to avoid areas that you have mowed.

All this furious action is accompanied by music in the background and a constant update

(continued on next page)

(continued from previous page)

of the score and high score.

If you want to change the speed, level or loudness simply press Escape. This will start the program again without clearing the high score.

Lines 10 to 280, main program; lines 290 to 450, initialising procedure; lines 460 to 490, introduction music; lines 500, 510, data for introduction music; lines 520 to 540, delay procedure; lines 550 to 650 set up the screen; lines 660 to 730, obstacles procedure; lines 740 to 790 print the oil cans; lines 800 to 850 print the mower; lines 860 to 900 check the colour in front of the mower; lines 910 to 940 print the readouts; lines 950 to 1010, ending procedure; lines 1020 to 1060 go on to next screen procedure; lines 1070 to 1090, music at each new screen; line 1100, data for the music at the end of the screen; lines 1110 to 1180, music during the game; lines 1190 to 1390, instructions.

When typing the program in leave out line 10 and put it in after the program is running.

```
  10 ON ERROR GOTO 30
  20 hi%=0:screen%=1
  30 MODE1:PROCinit:PROCinst
  40 live=2
  50 score=0:screen%=1
  60 VDU23;10,32;0;0;0;17,130,12
  70 PROCwall:PROCobst:PROCcans:PROCintro
  80 PROCinit
  90 REPEAT
 100 PROCprint_mower
 110 PROCwait(wait%)
 120 PROCdisplay
 130 PROCmusic
 140 IF INKEY(-98)=-1 THEN A%=*LEFT"
 150 IF INKEY(-67)=-1 THEN A%=*RIGHT"
 160 IF INKEY(-73)=-1 THEN A%=*UP"
 170 IF INKEY(-105)=-1 THEN A%=*DOWN"
 180 VDU17,3;31,x%,y%;233
 190 IF A%=*LEFT" THEN x%=x%-1
 200 IF A%=*RIGHT" THEN x%=x%+1
 210 IF A%=*UP" THEN y%=y%+1
 220 IF A%=*DOWN" THEN y%=y%-1
 230 VDU28;~col%+POINT(~x%32+16,(31-y%)X32+16):IF col%<>2 THEN PROCcheck
 240 score=score+0.1:oil=oil-0.1 IF score>51&screen%=1 THEN PROCupdate
 250 IF oil<=3 THEN SOUND2,2,1,1 ELSE SOUND&13,-0,0,0
 260 IF oil<=0 THEN PROCend
 270 UNTIL FALSE
 280                    ***************************************
 290 DEFPROCinit
 300 RESTORE 1150
 310 A%=*RIGHT":x%=15:y%=15:oil=40
 320 ENVELOPE1,1,6,6,6,250,255,255,126,-1,0,-10,126,80
 330 ENVELOPE2,4,6,-3,-3,4,2,2,0,0,0,-1,0,63,58
 340 VDU23,224,255,255,255,255,255,255,255,255
 350 VDU23,225,184,129,255,129,129,24,24,60
 360 VDU23,226,60,24,24,126,129,255,129,126
 370 VDU23,227,112,168,169,175,175,169,168,112
 380 VDU23,228,14,21,149,245,245,149,21,14
 390 VDU23,229,60,126,255,255,255,255,126,60
 400 VDU23,230,0,0,28,62,124,254,255,127
 410 VDU23,231,24,24,24,255,126,126,126,126
 420 VDU23,232,73,42,8,99,8,42,73,0
 430 VDU23,233,238,219,179,153,245,158,189,170
 440 VDU19,2,2;0;19,3,3;0;
 450 ENDPROC
 460 DEFPROCintro:RESTORE 500
 470 FOR music=1 TO 18:READ Pitch,duration:SOUND1,-(loudness%),Pitch,duration:N
EXT:music
 480 PRINTTAB(16,15);"          PROCwait(3000)
 490 ENDPROC
 500 DATA101,5,121,3,137,5,121,2,129,2,121,2,129,2,121,4,117,3
 510 DATA101,5,121,3,137,5,121,2,129,2,121,2,129,2,121,4,117,3
 520 DEFPROCwait(*T%)
 530 FOR delay%=1 TO T%:NEXT delay%
 540 ENDPROC
 550 DEFPROCwall
 560 VDU23,1,0;0;0;0;0;0;0;0;:PRINT"OIL ",TAB(2,31);"SCORE ";
 570 PRINTTAB(15,30);"MOWERS LEFT ";live;TAB(30,31);"SCREEN ";screen%;
 580 PRINTTAB(15,31);"HI-SCORE ";TAB(15,0);"<(MOWER)>";
 590 FOR wall=1 TO 30
 600   VDU31,wall-1,224,31,wall,28,224
 610   NEXT wall
 620 FOR wall=1 TO 20
 630   VDU31,1,wall-1,224,31,38,wall,224
 640   NEXT wall
 650 ENDPROC
 660 DEFPROCobst:COLOUR1
 670 FOR obst=1 TO screen%X4+6
 680   VDU31,RND(34)+1,RND(26)+1,229
 690   VDU31,RND(34)+1,RND(26)+1,238
 700   IF loudness%>0 THEN SOUND0,-15,6,1
 710   PROCwait(100)
 720   NEXT obst
 730 ENDPROC
 740 DEFPROCcans:COLOUR0
 750 FOR cans=1 TO level%:VDU31,RND(34)+1,RND(26)+1,231
 760   IF loudness%>0 SOUND2,1,1,1
 770   PROCwait(700):NEXT cans
 780 VDU17,0,31,15:15,228,17,3,31;16,15:PRINT" READY!":PROCwait(800)
 790 ENDPROC
 800 DEFPROCprint_mower
 810 IF A%="RIGHT" THEN VDU17,0,31,x%,y%,229
 820 IF A%="LEFT" THEN VDU17,0,31,x%,y%,227
 830 IF A%="UP" THEN VDU17,0,31,x%,y%,225
 840 IF A%="DOWN" THEN VDU17,0,31,x%,y%,226
 850 ENDPROC
 860 DEFPROCcheck
 870 IF col%=0 oil=oil+2 IF loudness%>0 SOUND2,1,1,1
 880 IF col%=3 THEN score=score-.1
 890 IF col%=1 THEN PROCend
 900 ENDPROC
 910 DEFPROCdisplay:COLOUR1
 920 IF score>hi% THEN hi%=score
 930 PRINT TAB(8,30);INT(oil);" ";TAB(9,31);INT(score);TAB(24,31);hi%;
 940 ENDPROC
 950 DEFPROCend:SOUND0,1,1,1
 960 SOUND&11,-0,0,0:SOUND&13,-0,0,0:VDU17,0,31,x%,y%,232:PROCwait(3000)
 970 live=live-1:IF live>0 THEN 60 ENDPROC
 980 score=0:NX15:0
 990 VDU17,0,30:PRINT"GERO!":PRINT"Press SPACE BAR to Play again!"
1000 REPEAT UNTIL GET=32 GOTO40
1010 ENDPROC
1020 DEFPROCupdate
1030 SOUND&11,-0,0,0
1040 PROCprint_mower:VDU17,0,31,11,14
1050 PRINT"SCREEN ";screen%;" COMPLETED!":PROCnewscreen
1060 PROCwait(5000):screen%=screen%+1 GOTO60:ENDPROC
1070 DEFPROCmusic:REPEAT
1080 FOR music=1 TO 6:READ Pitch,duration:SOUND1,-(loudness%),Pitch,duration
1090   NEXT music:ENDPROC
1100 DATA81,3,101,3,117,3,129,5,117,3,129,5
1110 DEFPROCmusic:IF RND(X(-6)X1 THEN ENDPROC
1120 READ Pitch,duration%:IF Pitch>0 THEN volume=0 ELSE volume=-(loudness%)
1130 IF duration%=999 THEN RESTORE 1150:ENDPROC
1140 SOUND1,volume,Pitch,duration:ENDPROC
1150 DATA 101,5,121,5,0,0,121,5,117,3,109,2,117,4,121,5,101,4,0,1,101,4,0,1
1160 DATA 101,4,121,5,0,0,121,5,117,2,109,2,117,4,121,5,101,4,0,1,101,4,0,1
1170 DATA 101,4,89,5,0,0,89,5,81,5,0,0,81,5,73,6,0,7,101,5,89,5,0,0,89,5
1180 DATA 81,5,0,0,81,5,73,6,0,10,999,999
1190 DEFPROCinst
1200 VDU17,1,31,15,0,225:PRINT" MOWER ";CHR$225
1210 VDU17,2,31,10,3,231:PRINT" By Shinpo Sugiura ";CHR$231;COLOUR3
1220 PRINT"  Having failed all your 'O' levels youronly job was as a lawn mow
er of a rratherfeculiar Garden..."
1230 PRINT"  There are many hazards to this job. For instance there are exp
losive cricketballs which you must obviously avoid andthere are rocks which wou
d blow you up if touched. On top of this your mower oil is limited."
1240 COLOUR2:PRINT"  To change levels Press ESCAPE."
1250 COLOUR1:PRINT"  Press SPACE BAR to continue!":REPEAT UNTIL GET=32 CLG
1260 VDU17,130,12,17,1,31,15,0 PRINT"CHARACTERS"
1270 VDU17,1,31,5,3,224 PRINT"  ----------Wall....."
1280 VDU17,0,31,5,5,228 PRINT"  ----------You....."
1290 VDU17,1,31,5,7,229 PRINT"  -Explosive cricet ball..."
1300 VDU31,5,9,238 PRINT"  ----------Rock....."
1310 VDU17,0,31,5,11,231 PRINT"  ----------Oil can...."
1320 COLOUR1:PRINT"  CONTROLS:-"
1330 PRINT"  Z ----------LEFT.."PRINT"  X ----------RIGHT.."
1340 PRINT"  ----------UP.." PRINT"  ----------DOWN.."
1350 COLOUR0:PRINT" Input speed 1(FAST) to 9(SLOW) ";:REPEATI%=INSTR("12345678
9",GET$):UNTIL15:PRINT:IF wait%=ITX10
1360 PRINT" Input level 1(HARD) to 5(EASY) ";:REPEATI%=INSTR("12345",GET$):UNT
IL15:PRINT:IF level%=IX4+3
1370 PRINT" Input loudness 0(SILENT) to 9(LOUD) ";:REPEATI%=INSTR("0123456789"
,GET$):UNTIL15:PRINT:IF loudness%=(I%-1)
1380 PRINT"  Press SPACE BAR to Play game!":REPEAT UNTIL GET=32
1390 ENDPROC
```

On the grid

Stephen Vine,
Redhill,
Surrey.

VIC-20

THIS PROGRAM for the Vic-20 plus a printer will create those puzzles in which a set of words are hidden in a grid of letters. All you have to do is to think of the actual words you want to be hidden, enter them and the program will randomly orientate them for someone to find.

Those of you who have no extra memory will have difficulties. It is possible to work the program but with these few changes: lines 310 to 360 should be left out. This is the alpha sort and is not essential. Also you will have to do away with the display and use up the screen RAM; do this by:

```
POKE 56,32
POKE 55, 0
CLR
POKE 648, 32 (return) (run/stop-restore)
```

Do this after entering and saving the program. After that you will not be able to see

(continued on page 141)

```
 10 INPUT"SIZE OF GRID";X,Y:DIMG$(X,Y)
 20 INPUT"NUMBER OF WORDS";N:DIMW$(N+INT(N/3+1)):GOSUB600
 30 DEFFNR(A)=INT(RND(1)*A)+1
 35 FORI=1TOG:READX(I),Y(I):NEXT
 40 FORI=1TON
 50 W=LEN(W$(I)):R=0
 60 GX=FNR(X):PX=GX
 70 GY=FNR(Y):PY=GY
 80 DR=FNR(8):XD=X(DR)
 90 YD=Y(DR)
100 FORJ=1TOW
110 IFG$(PX,PY)<>MID$(W$(I),J,1)ANDG$(PX,PY)<>""THEN200
120 PX=PX+XD:PY=PY+YD:IFPX<1ORPX>XORPY<1ORPY>YTHEN200
130 NEXT
140 FORJ=1TOW
150 G$(GX,GY)=MID$(W$(I),J,1):GX=GX+XD:GY=GY+YD:NEXT
160 NEXTI:GOTO300
200 R=R+1:IFR>XXYTHEN250
210 GOTO60
250 POKE36878,15:POKE36876,220:POKE36879,26
260 POKE162,0:WAIT162,64:POKE36878,0
270 PRINT"CANNOT ABLE TO FIT IN    "W$(I)" PLEASE ENTER
280 PRINT"ANOTHER (TRY A SHORTERONE)."
290 INPUT"WORD";W$(I):POKE36879,27:GOTO50
300 REM
310 T=0
320 FORI=1TON-1
330 IFW$(I)<W$(I+1)GOTO350
340 W$=W$(I):W$(I)=W$(I+1):W$(I+1)=W$:T=1
350 NEXT
360 IFT=1THEN310
370 TB$=CHR$(16)
380 CN=(80-2XX-2)/2:CN$=TB$+MID$(STR$(CN),2)
381 GR$=CHR$(8)+TX$=CHR$(15)+CR=CN+2XX
382 CR$=TB$+MID$(STR$(CR),2)
```

(listing continued on page 141)

A totally portable computer that runs on its own power supply for use anywhere.

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ZX81 16K £3·95

KRAZY KONG

All machine code version of the popular arcade game. This program has all the features of the original and is every bit as fast. 3 different screens make it difficult to beat.

ZX81 16K £3·95

HOPPER

Entirely written in machine code. This excellent version of the arcade game is very addictive. See if you can get the frogs back to the lilly pond. (Available end of February 1983).

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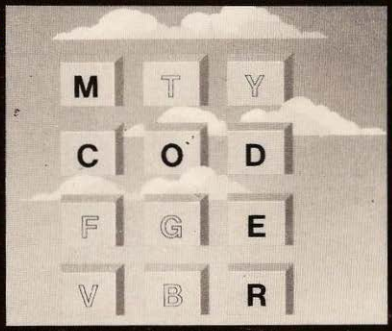
PSS makes *M*achine Code Redundant!

Now there is no need to spend long tedious hours writing and debugging your programs in laborious machine code - let MCoder from PSS do all the hard work for you....

MCoder is the first real integer compiler for The Sinclair Spectrum. This very sophisticated piece of software will simply translate basic programs into machine code for you, giving an average speed improvement of the order of 75 times although in certain cases the improvement can be as much as 900 times faster.



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SEND CHEQUE OR P.O. TO PSS 452 STONEY STANTON ROAD COVENTRY CV6 5DG.

(continued from page 138)

what you are typing so go slowly. Now type Run and Return. Now you have to input the size of the grid — the number of letters in X and Y directions, try 18,18 and press Return.

Next you are asked for the number of words: 20 is a reasonable amount. Then you type in the words, be careful if you have no screen. You will have to wait a while as it fits them in, if the screen border goes red it wants you to enter a different, preferably shorter, word. When it wants another input this will be the title. After typing that it prints the solution plus the puzzle and list of words. Press Y for another copy of the puzzle or press N for entering a different one.

Those with expansion fitted will have no difficulties. The printer used was the Seikosha OP-100VC.

(listing continued from page 138)

```
385 OPEN3,4
387 INPUT"TITLE";TL$
388 CT=INT(40-LEN(TL$)):CT=TB#+MID$(STR$(CT),2)
389 PRINT#3,CHR$(14)"SOLUTION":PRINT#3
390 FORJ=1TOY:FORI=1TOX:IFG$(I,J)=""THENPRINT#3," ";
395 PRINT#3,G$(I,J);:NEXT:PRINT#3:NEXT:PRINT#3:PRINT#3:PRINT#3
400 PRINT#3,CHR$(14)CT#TL$:PRINT#3,TX#
410 FORI=1TOX:FORJ=1TOY:IFG$(I,J)>""THENG$(I,J)=CHR$(FNR(26)+64)
420 NEXTJ,I
425 PRINT#3,CN#",";:FORK=2TO2*X:PRINT#3,"-";:NEXT:PRINT#3,"\"OR#
430 FORJ=1TOY:PRINT#3,TX#CN#":";FORI=1TOX-1
440 PRINT#3,G$(I,J)" ";:NEXT:PRINT#3,G$(X,J)"|"OR#:PRINT#3,TX#CN#"|"CR#"|"OR#:NE
XT
441 PRINT#3,TX#CN#"\";FORK=2TO2*X:PRINT#3,"-";:NEXT:PRINT#3,"/"
445 C1#=CHR$(16)+"25":C2#=CHR$(16)+"50"
446 PRINT#3:PRINT#3:PRINT#3,TX#
447 AB=INT(N/3+.5)+1
450 FORI=1TOAB:PRINT#3,W$(I)C1#W$(I+AB)C2#W$(I+AB#2):NEXT:PRINT#3:CLOSE3
460 PRINT"ANOTHER COPY (Y/N)":POKE198,0
470 GET#:IFA$<>"Y"ANDA$<>"N"THEN470
480 IFA$="Y"THENOPEN3,4:PRINT#3:GOTO400
490 RUN
500 DATA1,0,1,1,0,1,-1,1,-1,0,-1,-1,0,-1,1,-1
600 FORI=1TON
610 INPUTW$:IFW$=CHR$(13)THEN610
620 W$(I)=W$:NEXT:RETURN
```

Drumbeat

David Squires,
St Andrews,
Fife.

SPECTRUM

THIS SHORT program, written for either version of the ZX Spectrum, expands the idea of machine-code sound effects to produce a rhythm generator.

It is deliberately not too long or elaborate as this would mean losing some of the speed so essential to the program. The program itself suffers from the Spectrum's usual lack of volume but even without headphones or amplification, some fairly impressive rhythms can be produced.

You have two instruments at your command; the bass drum and side-drum with snare. When the program is run, it asks you for first the length of the note of the bass drum, then the length of the note of the snare drum. It then asks you for the number of bars the rhythm is to be played and finally the rhythm the machine is to play each bar. This is fed into the computer as a string of letters, with B for a note on the bass drum and S for a note on the snare drum. The other letter that can be input is P, for pause. Two or more can be written for longer pauses. Therefore BBSSPPSBBP would be read as two notes on the bass, then two on the snare, a short pause, another on the snare, two more on the bass and finally a very short pause.

Incidentally, if you are using headphones or amplification, the Mic socket gives a more faithful reproduction of the sound you hear from the Spectrum's own speaker but the Ear socket gives a sharper, louder, more percussive sound.

```
  10 REM ***Rhythm Generator****
  20 REM *For 16/48k ZX Spectum*
  30 GO TO 60
  40 POKE 32505,(lb*t)/2: POKE 3
2507,1: LET c=USR 32500: RETURN
  50 POKE 32505,(ls*t)/2: POKE 3
2507,0: LET c=USR 32500: RETURN
  60 CLEAR 32499
  70 GO SUB 200
  80 INPUT "Tempo(0-5)?";t
  90 INPUT "Lenth bass drum ?(0-
5)";lb: INPUT "Lenth snare ?(0-5
)";ls: LET ls=ls*5: INPUT "No. b
ars? ";b
 100 INPUT "Rhtym ";a$
 110 FOR k=1 TO b
 120 FOR v=1 TO (LEN a$)
 130 IF a$(v)="b" THEN GO SUB 40
 140 IF a$(v)="s" THEN GO SUB 50
 150 IF a$(v)="p" THEN PAUSE t+(
t=0)
 160 NEXT v: PAUSE t+(t=0): NEXT
k: STOP
 200 FOR a=32500 TO 32528
 210 READ n: POKE a,n: NEXT a
 220 DATA 6,1,197,33,15,1,17,1,0
,229,205,181,3,225,17,100,0,167,
237,90,125,254,255,32,237,193,16
,230,201
 230 RETURN
```

Millipede

M G Crossley,
Heywood,
Lancashire.

ACE

THIS PROGRAM is written in Jupiter Ace Forth. It is entitled Millipede and is based upon a program written by Andrew Weekes in Spectrum Basic published in *Your Computer*, February 1983. As there is a great shortage of Ace Forth software I hope Mr Weekes will not mind my using his algorithm.

I have tried to use descriptive colon definition names in an endeavour to make the coding self-explanatory. However, this is at the expense of memory and is not strictly necessary. The program as it stands occupies approximately 2K, 4 bytes, and requires a memory expansion to the Ace — I use a converted ZX-81 RAM pack. It may be possible, by cutting out the frills, to reduce the memory requirement and still have a playable game using the standard RAM only.

In the colon definition Once-More the word Millipede is used. At the time Once-More is being defined Millipede does not exist in the vocabulary. Therefore, it is necessary to define Once-More omitting Millipede and then when all the program has been typed in, edit Once-More putting Millipede in its correct position and then redefine Once-More. Anyone who has used the Ace for a short time will understand the procedure. A similar situation — recursion — is covered in the Ace manual chapter 3, exercise 7, page 53.

One interesting definition which I think is not covered in the Ace manual and which could be useful elsewhere is Screen-Peek. This colon definition expects the stack to contain the row, column print-head position and returns with the ASCII value of the character at the print-head position on top of the stack.

```
0 VARIABLE SEED
\
0 VARIABLE A
\
0 VARIABLE B
\
0 VARIABLE G
\
0 VARIABLE H
\
0 VARIABLE M
\
0 VARIABLE P
\
0 VARIABLE S
\
: SETUP
  7 A ! 23 B ! 0 G !
  0 M ! 15 P ! 0 S !
;
\
: LONG-DELAY
  20000 0 DO LOOP
;
\
: SHORT-DELAY
  200 0 DO LOOP
;
\
: 2DUP
  OVER OVER
;
\
: PRINT
  AT
  ." MILLIPEDE"
;
\
: RIGHT
  23 0 DO I DUP PRINT LOOP
;
\
: CENTRE
  23 0 DO I 11 PRINT LOOP
;
\
: LEFT
  23 0 DO I DUP 22 SWAP - PRINT LOOP
;
\
: TITLE
  10 0 DO CLS RIGHT SHORT-DELAY
  CLS CENTRE SHORT-DELAY
  CLS LEFT SHORT-DELAY
  LOOP CLS CENTRE
;
```

(continued on page 143)

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* Reviewed in ZX Computing Aug/Sept 1982 and Popular Computing Weekly 22/7/82.

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(continued from page 141)

```
HI-SOUND
  30 100 BEEP

LOW-SOUND
  60 100 BEEP

PAUSE
  BEGIN INKEY UNTIL HI-SOUND LOW-SOUND

HARDNESS
  CLS CR CR
  ." Enter The Hardness Level (2-10)"CR
  QUERY LINE DUP DUP 11 < SWAP 1 > AND
  IF H ! 1000 0 DO LOOP
  ELSE DROP HARDNESS THEN

INSTRUCTIONS
  CLS
  ." Hit any key to continue"CR CR
  ." Guzzle down the bugs"CR CR
  ." Without hitting the walls"CR CR
  ." Left 'Z' & SPACES ." Right 'M'"CR
  PAUSE

MIL
  60 189 102 165 102
  165 126 60 1

BUG
  24 60 153 126 60
  255 60 219 2

GRAPH
  @ # 11263 + DUP @ +
  DO I C! -1 +LOOP

DEF-GRAPH
  MIL GRAPH BUG GRAPH

WALL-PRINT
  20 DUP P @ AT 46 EMIT
  @ @ AT 46 EMIT

RANDOMISE
  SEED @ 75 U* 75 0 D+
  2DUP U< ~ - 1- DUP SEED !

RND
  RANDOMISE U* SWAP DROP

BUG-PRINT
  10 RND 1+ 9 >
  IF 20 A @ DUP B @ SWAP
  ~ 2 / + AT 2 EMIT THEN

SCREEN-PEEK
  AT 15360 @ C@

ONCE-MORE
  CLS
  ." DO YOU WANT TO PLAY AGAIN"CR
  BEGIN INKEY ?DUP UNTIL DUP 121 =
  IF DROP MILLIPEDE
  ELSE 110 =
  IF CLS CR CR
  ." Bye for now."CR LONG-DELAY ABORT
  ELSE ONCE-MORE
  THEN THEN

ENDIT
  CLS 9 0 DO
  ." YOU SNUBBED YOUR NOSE ON THE"CR
  ." TUNNEL WALL"CR LOOP LONG-DELAY CLS 6 0 AT
  ." You scored " S @ 10 / DUP .
  ." Points."CR CR
  ." You ate " G @ DUP .
  ." grubs"CR CR
  ." That's " + .
  ." in total" LONG-DELAY ONCE-MORE

CHECK-OUT
  SCREEN-PEEK 46 =
  IF ENDIT THEN

NOSE-SNUB
  15 P @ CHECK-OUT
  16 P @ CHECK-OUT

G+
  G @ 1+ G !

EAT-BUG
  16 P @ SCREEN-PEEK 32 = @=
  IF G+ LOW-SOUND HI-SOUND THEN

MIL-PRINT
  15 P @ AT 1 EMIT

SCROLL
  22 32 AT 32 EMIT CR

SUPDATE
  S @ 1+ S !

MUPDATE
  H @ DUP RND SWAP 2 / - ?DUP
  IF 3 RND + M !
  ELSE MUPDATE THEN

AUPDATE
  A @ DUP -1 >
  IF M @ + THEN A !

BUPDATE
  B @ DUP 31 <
  IF M @ + THEN B !

A2UPDATE
  A @ DUP 1 <
  IF M @ ABS + A ! B @ M @ ABS + B !
  ELSE DROP THEN

B2UPDATE
  B @ DUP 28 >
  IF M @ ABS - B ! A @ M @ ABS - A !
  ELSE DROP THEN

UPDATE
  SUPDATE MUPDATE AUPDATE BUPDATE
  A2UPDATE B2UPDATE

MIL-CLEAR
  15 P @ AT 32 EMIT

GETKEY
  INKEY DUP 122 =
  IF DROP P @ 1- P !
  ELSE 109 =
  IF P @ 1+ P ! THEN THEN

MILLIPEDE
  SETUP TITLE HARDNESS INSTRUCTIONS
  DEF-GRAPH BEGIN WALL-PRINT BUG-PRINT
  NOSE-SNUB EAT-BUG MIL-PRINT SCROLL
  UPDATE MIL-CLEAR GETKEY 0 UNTIL
```

Blitzkrig

Martin Exall,
Drayton,
Norwich.

ATOM

WRITTEN FOR a fully expanded Acorn Atom, this program uses high-resolution graphics and the characters which are defined are placed in the floating-point variable space. The program uses a machine-code routine to draw the characters on the screen. If you succeed in destroying all the buildings then the plane will land and then take off again for another go at a more difficult level. The program is written in subroutines and includes Rem statements so it should be fairly easily converted to other micros. The height of the buildings depends on the difficulty level which is set in line 3120 — the higher the number is, the higher the buildings can be. There are buildings all across the screen and they all have to be destroyed before the plane can land. Only six sections of the building can be destroyed with any one bomb.

```
140 GOSUB 1000;REM MACHINE CODE
150 GOSUB 2000;REM DEFINE CHARACTERS
160 GOSUB 3000;REM INSTRUCTIONS
170 GOSUB 4000;REM DRAW BUILDINGS
180 GOSUB 6000;REM PRINT SCORE
190 B=#8000;V=0;W=0;E=0
200 IF ?#B001(128 OR E<>0 GOSUB 7000;
    REM BOMB DROP
210 X=V;Y=W;C=9;GOSUB 5000
222 V=V+1;B=B+1;IF V<32 GOTO 240
230 W=W+1;V=0;B=#8000+W*256
240 IF B=#951E GOTO 8000;REM LAND
250 IF ?B<>0 GOTO 9000;REM CRASH
260 X=V;Y=W;C=6;GOSUB 5000
270 GOTO 200
999 END
1000 REM MACHINE CODE
1010 REM TO PLOT CHARACTERS
1020 PRINT #21
1030 DIM ZZ(1),P(-1)
1040F
1050 Z20 LDX #0;LDY #0
1060:ZZ1 LDA (#82),Y;STA (#80,X)
1070 INY
1080 LDA #80;CLC;ADC #*20;STA #80
1090 LDA #81;ADC #0;STA #81
1100 CPY #8;BNE ZZ1
1110 RTS
1120J
1130 PRINT #6
1140 RETURN
2000 REM DEFINE CHARACTERS
2010 Z=#2000
2020 !Z=#7E5A7E5A;Z!4=#7E5A7E5A
2030 Z!8=#5A5A7E5A;Z!12=#7E5A5A7E
2040 Z!16=#7E667E66;Z!20=#7E667E66
2050 Z!24=#3C3C1818;Z!28=#7E5A7E24
2060 Z!32=#18183C3C;Z!36=#5A7E5A3C
2070 Z!40=#18181818;Z!44=#7E667E3C
2080 Z!48=#C0800000;Z!52=#003F7FFE
2090 Z!56=#3C183C7E;Z!60=#183C7E7E
2100 Z!64=#7078381C;Z!68=#50707070
2110 Z!72=0;Z!76=0
2120 Z!80=#2A26221C;Z!84=#1C2232
2130 Z!88=#08081808;Z!92=#10808
2140 Z!96=#1C02221C;Z!100=#3E2020
2150 Z!104=#0C02221C;Z!108=#1C2202
2160 Z!112=#3E140C04;Z!116=#040404
2170 Z!120=#023C203E;Z!124=#1C2202
2180 Z!128=#3C2020!C;Z!132=#1C2222
2190 Z!136=#0004023E;Z!140=#202010
2200 Z!144=#1C22221C;Z!148=#1C2222
2210 Z!152=#1E22221C;Z!156=#1C0202
2220 RETURN
3000 REM INSTRUCTIONS
3010 PRINT #12
3020 PRINT "              BLITZ"'
3030 PRINT "YOU ARE IN AN AEROPLANE FLYING  "
3040 PRINT "OVER A LOT OF BUILDINGS. YOU    "
3050 PRINT "HAVE TO FLATTEN THE BUILDINGS BY"
3060 PRINT "DROPPING BOMBS ON THEM SO YOU   "
3070 PRINT "CAN LAND ON THE GROUND."'
3080 PRINT "YOU DROP THE BOMBS BY PRESSING  "
3090 PRINT "THE shift KEY."'
3100 PRINT "              PRESS ANY KEY WHEN READY"
3110 LINK #FFE3;REM WAIT FOR KEYPRESS
3120 D=5;REM DIFFICULTY
3130 S=0;REM SCORE
3140 RETURN
4000 REM DRAW BUILDINGS
4010 CLEAR 4
4020 FOR Z=2 TO 29
4030 C=ABSRND%3
4040 FOR H=21 TO (21-(ABSRND%D+1)) STEP -1
4050 X=Z;Y=H;GOSUB 5000;REM PLOT CHARACTER
4060 NEXT H
4070 C=C+3
4080 X=Z;Y=H;GOSUB 5000
4090 NEXT Z
4100 MOVE 0,15;DRAW 255,15
4110 RETURN
5000 REM PLOT CHARACTER
5010 ?#83=#20
5020 ?#82=C*8
5030 ?#81=#80+Y
5040 ?#80=X
5050 LINK Z20
5060 RETURN
6000 REM PRINT SCORE
6010 STR S,S40
6020 Z=0
6030 DO
6040 C=S40?Z;C=C-30
6050 X=10+Z;Y=23
6060 GOSUB 5000
6070 Z=Z+1
6080 UNTIL S40?Z=CH"."
6090 RETURN
7000 REM DROP BOMB
7010 IF E=1 GOTO 7030
7020 E=1;F=V;G=W;I=B;J=B
7030 X=F;Y=G;C=9;GOSUB 5000
7040 G=G+1;I=I+256
7050 IF ?I<>0 AND ?I<>255 J=J+1;S=S+1;X=F;Y=G;
     C=9;GOSUB 5000
7060 IF G=22 OR J=6;E=0;GOSUB 6000;RETURN
7070 X=F;Y=G;C=7;GOSUB 5000
7080 RETURN
8000 REM LAND
8010 FOR Z=0 TO 5
8020 PRINT #7
8030 NEXT Z
8040 DO
```

(continued on next page)

(continued from previous page)

```
8050 X=V;Y=W;C=9;GOSUB 5000
8060 X=V+2;IF V>31 V=0
8070 W=W-1
8080 X=V;Y=W;C=6;GOSUB 5000
8090 UNTIL W=0
8100 D=D+2
8110 GOTO 170
9000 REM CRASH
9010 V=V-1;B=B-1;DO
9020 X=V;Y=W;C=8;GOSUB 5000
9030 FOR Z=0 TO 10;WAIT;NEXT Z
9040 X=V;Y=W;C=9;GOSUB 5000
9050 W=W+1;B=B+256
9060 UNTIL ?B>0 OR ?(B+256)=255
9070 X=V;Y=W;C=8;GOSUB 5000
9080 FOR Z=0 TO 120;WAIT;NEXT Z
9090 PRINT #12
9100 PRINT '''''                    you crashed"''
9110 PRINT "YOU SCORED "S''
9120 INPUT "DO YOU WANT ANOTHER GAME"*$40
9130 IF ?$40=CHV"Y";GOTO 160
9140 IF ?$40()CH"N";PRINT #11;LINK #FE22;GOTO 9120
9150 END
>
```

Multiline delete

Chris Dellarocas,
Athens,
Greece.

ZX-81

THE LACK of a Delete command in ZX-81 Basic has been in my opinion a major shortcoming in a machine where the lack of Data/Read, the lack of a machine-code monitor and the limitations of memory have been forcing programmers to create and then line-by-line delete lengthy loaders and initialisers. Just think of the initialisation program of Simon Lane's Dog Race — *Your Computer* July 1982. It comprises 126 lines.

Such reasons have prompted me to write the Multiline Delete routine. It just takes 54 bytes and can be used without problem in both 1K and 16K systems, in Fast or Slow mode. The routine deletes any number of any program lines — including line 0 — contained between two given line numbers — Poked to locations FirstL and LastL, see programs. While — and this is most important — conserving all existing Basic variables.

The routine is relocatable with no changes to be made when moving it up or down in memory. The only point needed to be taken into account is the locations of the two words FirstL and LastL. I consider it more useful to move it above RAMtop and have it sit there during Loads and Saves. That is why I have written an optional relocator occupying 12 more bytes. You can easily omit that if you wish to do so.

The routine is written around two very useful ROM routines. The first, starting at 09D8H, returns the starting address of a given Basic line in HL and is used to determine the limits of the block of memory that is to be deleted. The second, starting at 09ADH, changes all pointers — that is, system variables between DFile and STKend — that do not point lower than HL, by adding them to the value in BC.

I have written a short Basic program to load, lines 100-150, relocate, lines 10-20, drive the routine and also demonstrate some of its features.

Create a 1 Rem statement with 66 full stops, and then type

```
POKE 16510,0
```

and key in the Basic program. Now type Run and enter the hex code. When you have finished and checked it, type Cont and start your cassette recorder. The program will be Saved under the name Vel and then automatically Run. Lines 10-20 will relocate the Del routine to 7F00, while lines 30-70 will use the same routine to delete unwanted lines 0-199. When you now List, you will find yourself left with lines 900 onwards. Type Goto 9000 to discover that A$ has been kept intact. You can now use the program through the Basic driver — lines 9988-9999 — and its operation should present no problems. However, you should note some of the following points: you do not have to enter the exact starting and finishing lines of the block you want deleted.

The routine usually — but not always — causes the Basic program from which it is called to halt the report code.

Under normal operation the program cannot crash. But never enter a first line number larger than the very last line of the resident Basic program. Also, avoid last line numbers larger than 16382. First line numbers should never be larger than last line numbers.

1K users will probably want to leave the routine sitting in the Rem statement. Also, they will have to change the locations of FirstL and LastL in memory by changing their references in the hex listing — locations 16523-24 respectively.

Calling addresses are:

USR 16514 for the Del routine if not moved
USR 16568 for the Relocator

```
START:16514      LENGTH:54
DEL:
  LD HL,(FIRSTL)        2A BC 7F
  CALL 09D8H            CD D8 09
  PUSH HL               E5
  PUSH HL               E5
  LD HL,(LASTL)         2A BE 7F
  INC HL                23
  CALL 09D8H            CD D8 09
  EX DE,HL              EB
  LD HL,(DFILE)         2A 0C 40
  AND A                 A7
  SBC HL,DE             ED 52
  JR NC,NOLAST          30 04
LAST:
  LD DE,(DFILE)         ED 5B 0C 40
NOLAST:
  LD HL,(E-LINE)        2A 14 40
  PUSH HL               E5
  AND A                 A7
  SBC HL,DE             ED 52
  PUSH HL               E5
  POP BC                C1
  EX DE,HL              EB
  POP AF                F1
  POP DE                D1
  PUSH AF               F5
  LD DE,[redacted]      ED B0
  EX DE,HL              EB
  POP DE                D1
  AND A                 A7
  SBC HL,DE             ED 52
  PUSH HL               E5
  POP BC                C1
  POP HL                E1
  JP 09ADH              C3 AD 09

FIRSTL=32700
LASTL=32702

RELOCATOR FOR ABOVE PROGRAM
START:16568      LENGTH:12

RELOC:
  LD HL,4002H           21 02 40
  LD DE,7F00H (*)       11 00 7F
  LD BC,036H            01 36 00
  LDIR                  ED B0
  RET                   C9

(*) DESTINATION ADDRESS-CAN BE
CHANGED TO YOUR REQUIREMENTS.
```

```
TENT BASIC    VARIABLES."
  4 REM [redacted]
  5 IF PEEK 16514()42 THEN GOTO
100
 10 POKE 16369,127
 20 LET Q=USR 16566
 30 POKE 32700,0
 40 POKE 32701,0
 50 POKE 32702,200
 60 POKE 32703,0
 70 LET Q=USR (127*256)
 99 REM [redacted]
100 FOR X=16514 TO 16579
110 INPUT A$
120 POKE X,CODE A$*16+CODE A$(2
)-476
130 PRINT A$;"  ";
140 NEXT X
150 STOP
198 SAVE "DEL"
199 RUN
9000 PRINT A$;'''
9987 REM [redacted]
9988 LET FL=32700
9989 LET LL=32702
9990 PRINT "DELETE FROM ";
9991 INPUT A
9992 POKE FL,A-256*INT (A/256)
9993 POKE FL+1,INT (A/256)
9994 PRINT A;" TO ";
9995 INPUT B
9996 POKE LL,B-256*INT (B/256)
9997 POKE LL+1,INT (B/256)
9998 PRINT B
9999 LET Q=USR (127*256)
```

Sound editor

J W Harrison,
Wigan,
Lancashire.

ATARI

SOUND EDITOR for the Atari 400/800 runs in 16K and uses the variables: V, N, D, L, where: V is the Voice or sound channel selected, N the note, D the distortion factor and L the loudness or volume. A green pointer is used to indicate the last selection keyed in. The program allows for either one voice or all four to be used singularly or together.

To switch off any voice, key in:

V,0,0,0

where V is the voice to be switched off: for example

Sound 1,0,0,0

switches off voice 1.

Atari users can refer to the hardware manual for further guidance in the use of distortion as some combinations of V, N, D, L will cancel out to produce silence. The program is self-explanatory as it runs and Rem statements in the listing help explain how it is put together.

```
10 REM << SOUND EDITOR >>
15 REM # by J.W.Harrison #
16 REM ## SET UP TITLE PAGE ##
20 GRAPHICS 17
30 POSITION 3,4
40 ? #6;"### SOUND ###"
50 POSITION 3,8
60 ? #6;"### EDITOR ###"
70 POSITION 3,12
80 ? #6;"PRESS [START]"
90 POSITION 5,14
100 ? #6;"TO BEGIN"
110 SOUND 0,66,12,8:SOUND 1,60,12,8
```

(continued on page 149)

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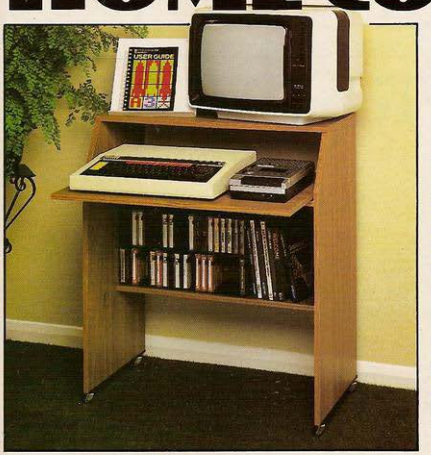

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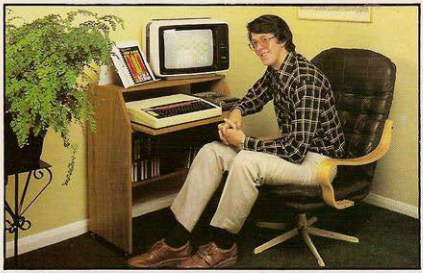

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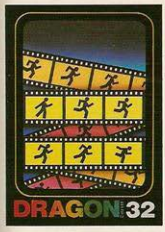

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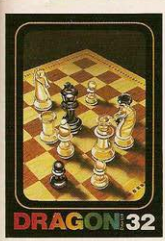

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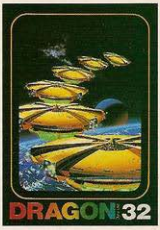

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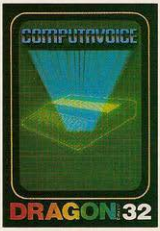

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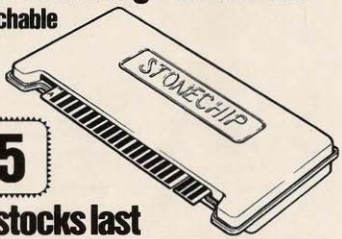

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(continued from page 144)

```
115 REM ** CHECK FOR [START] BEING PRESSED **
120 IF PEEK(53279)<>6 THEN 120
130 SOUND 0,0,0,0:SOUND 1,0,0,0
135 REM ** SET UP GRAPHICS 1 WITH TEXT **
140 GRAPHICS 1
150 ? "SELECTION WILL BE DISPLAYED ABOVE---"
160 ? "WHICH VOICE (0-3)";:INPUT V
170 IF V>3 THEN 160
175 REM ** CLEAR TEXT: PRESS [ESC],THEN
176 REM PRESS [CTRL] AND [CLEAR] TOGETHER **
180 ? ")":REM ** CLEAR TEXT **
190 ? "NOTES GO FROM HIGH(0) TO LOW(255)-"
200 ? "WHICH NOTE (0-255)";:INPUT N
210 IF N>255 THEN 200
220 ? ")":REM ** CLEAR TEXT **
230 ? "DISTORTION EFFECTS VARY (EXPERIMENT)-"
235 ? "EVEN NUMBERS ONLY---"
240 ? "WHAT DISTORTION (0-14)";:INPUT D
245 IF D>14 THEN 240
250 ? ")":REM ** CLEAR TEXT **
260 ? "VOLUME RUNS FROM OFF(0) TO LOUD(15)-"
270 ? "HOW LOUD (0-15)";:INPUT L
280 IF L>15 THEN 270
285 REM ** DISPLAY SELECTION TO GRAPHICS SCREEN **
290 IF V=0 THEN POSITION 0,0
300 IF V=1 THEN POSITION 0,4
310 IF V=2 THEN POSITION 0,8
320 IF V=3 THEN POSITION 0,12
329 REM ** TYPE sound IN INVERSE VIDEO **
330 ? #6;"sound ";V;",";N;",";D;",";L;"    "
331 REM ** 4 SPACES BETWEEN LAST QUOTE MARKS **
340 SOUND V,N,D,L
345 REM ** COLOR 2B SELECTS GREEN POINTER
346 REM ** COLOR 0 ERASES IT. POINTER USED
347 REM ** TO INDICATE LAST SELECTION KEYED
350 COLOR 0:PLOT 18,0:PLOT 18,4:PLOT 18,8:PLOT 18,12
360 IF V=0 THEN COLOR 2B:PLOT 18,0
370 IF V=1 THEN COLOR 2B:PLOT 18,4
380 IF V=2 THEN COLOR 2B:PLOT 18,8
390 IF V=3 THEN COLOR 2B:PLOT 18,12
400 ? ")":REM ** CLEAR TEXT **
410 GOTO 160:REM ** RETURN FOR NEXT SELECTION **
420 END
```

Memory display

I K Biddle,
Nuneaton,
Warwickshire.

BBC

A J HYNDS' program, December *Your Computer*, is quite a useful idea for memory display but has two distinct disadvantages. First, it requires about a page of user memory, and secondly Page must be altered in order to prevent the initial program being overwritten. I wrote this machine-code program with these considerations in mind. The program uses no memory allocated to the user since it is located in disc space at &D00. The assembled program requires about 225 bytes in &D00 and five bytes at &70.

To use the program type

RUN <CR>

and wait until the prompt returns. Then type

CALL 5% <CR>

The program should then wait until a four-digit hex number is input. It it does not, re-check the listing.

In order for the program to operate, all leading zeros must be input. Scrolling is achieved by pressing Shift and to exit, press Escape. The program can be called from Basic and trapped with the statement:

ON ERROR GOTO . . .

when the user presses Escape. The display format can be changed by altering line 820 to read

JSR &FFE7

All error checking has been made and will not accept alphanumerics outside the range 0-9 and A-F. Incidentally, the location at &D7 returns a non-ASCII value of a keyboard input and Escape is the value 240.

```
 40FORI=0TO1:P%=&D00:
  %%=P%:[OPTI*3
 50.INP  LDX#0
 60.LP1  LDA M%,X
 70      CMP#3D
 80      BEQ get
 90      JSR &FFEE
100      INX
110      BNE LP1
120.get  LDY#0
130.LP2  LDX#0
140.LP3  JSR &FFE0
150      CMP#71
160      BCS LP3
170      CMP#58
180      BCC CH2
190.CH1  CMP#64
200      BCC LP3
210      JMP CH3
220.CH2  CMP#47
230      BCC LP3
240.CH3  JSR &FFEE
250      STA &70,X
260      LDA &70,X
270      CMP#3A0
280      BCS SUB
290      CLD
300      SEC
310      SBC#330
320      STA &70,X
330      JMP OK
340.SUB  CLD
350      SEC
360      SBC#337
370      STA &70,X
380.OK   CMP#64
390      BEQ MUL
400      INX
410      BNE LP3
420.MUL  CLC
430      CLD
440      LDX#3OF
450      LDA &70
460.LP4  ADC &70
470      DEX
480      BNE LP4
490      ADC &71
500      STA &73,Y
510      CPY#301
520      BEQ PNT
530      INY
540      BNE LP2
550.PNT  LDA#14
560      JSR &FFE3
570      LDA#12
580      JSR &FFE3
590      JSR &FFE7
600      JSR &FFE7
610      LDX &73
620      LDY &73
630      STY &81
640      LDY &74
650      STY &80
660.LP5  TYA
670      JSR &8570
680      TYA
690      JSR &856A
700      LDA(&80),Y
710      JSR &856A
720      LDA(&80),Y
730      CMP#&20
740      BCS LP6
750      LDA#&20
760      JMP LP7
770.LP6  CMP#&7E
780      BCC LP7
790      LDA#&20
800.LP7  JSR &FFEE
810      LDA#&20
820      JSR &FFEE
830      LDA &D7
840      CMP#&F0
850      BEQ LP8
860      INY
870      BNE LP5
880      INC&81
890      INX
900      BNE LP5
910.LP8  RTS:]
920NM%=P%+1:%M%=CHR$12+
    "Type in start
     address (Hex.) "
930NEXT
```

Forth connection

P Sharp,
Maidstone,
Kent.

ATOM

THIS IS Connect Four for the Acorn Atom in 2K — 0.5K of this is graphics. The object is to get a row of four counters in a grid. This is done by using the Repeat key to move across the top and Shift to drop the counter. There are sound effects, a score of each game won and alternate goes.

The computer tells you whose move it is and inverts two counters on the winning line when a person has won.

```
10E=0;L=0;@=0;F=1
20CLEAR0
30IN."INSTRUCTIONS Y/N"V;IFV=Y GOS.x
40DIMAA14;I=0
50I=I+1;AA(I)=0;IF I<13 G.50
60CLEAR0;R=0;D=0;H=0;G=0;T=#0F;U=#18;S=#40;Z=0;I=0
70P.$12"   O WINS "E"    X WINS "L;?#801B=S;?#801C=S
80I=I+1;AA11=#801F+I;?AA11=#F0;IFI<32 G.80
90I=0
100 I=I+1;A=A+1;B=#8064+A;?B=#F0;IFI<14 G.100
110A=A-20;D=D+64;A=D;IFD>448 I=0;G.100
120I=0
130I=I+1;H=#8064+G;?H=#FF;G=G+32;IF I<16 G.130
140Z=Z+2;G=Z;IFG <>16 I=0;G.130
150IF F=1 X=U;G.170
160aX=T;O=#8F
170AA12=AA12+1;IFAA12=43 G.w
180?#8043=X;?#8134=X;?#8136=#14
190?#8137=T;?#8139=#8D;?#813A=T;?#813B=#16;?#813C=#05
200I=0
210I=I+1;AA13=#8155+I;IF I<8 G.210
220bI=0
230IF(?#8002%64<>64G.260
240IF?#8001<>#FF G.c
250G.230
260IFQ=2;?C=S
270C=#8045+I;I=I+2;?C=X;Q=2;WAIT;IFI=14G.b
280G.230
290cIFC=#8043G.b
300 IF C=#8045 M=6-AA2;AA2=AA2+1;G.h
310 IFC=#8047 M=6-AA3;AA3=AA3+1;G.h
```

(continued on page 151)

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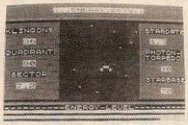

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(continued from page 149)

```
320 IFC=#8049 M=6-AR4;AR4=AR4+1;G.h
330 IFC=#804B M=6-AR5;AR5=AR5+1;G.h
340 IFC=#804D M=6-AR7;AR7=AR7+1;G.h
350 IFC=#804F M=6-AR8;AR8=AR8+1;G.h
360 IFC=#8051 M=6-AR9;AR9=AR9+1;G.h
370G.160
380hIFMK1G.230
390I=0;A=0;A=A+M
400I=I+M;?C=S;C=C+64;?C=X;P.$?;A=A-1;IF A=0G.u
410G.400
420C=#8043;IFX=U;G.a
430X=U;O=#98;G.170
440xP.$12"    CONNECT 4"'"    ---------"
450P.'''"TO WIN GET A LINE OF o \ x.IN A "
460P."VERTICAL,HORIZONTAL OR DIAGERNALLINE"
470P.'''"CONTROLS"'''rept TO MOVE"
480P.'"shift TO DROP COUNTER"'''"two Players only";A=0
490A=A+1;WAIT;IFA<530G.490
500R.
510w?#8134=#93;?#8135=#94;?#8136=#81;?#8137=#8C;?#8138=#85
520?#8139=#8D;?#813A=#81;?#813B=#94;?#813C=#85
530L.I.#FB7D;IN.'''ANOTHER GO Y/N"R;IFR=NJG.570
540IFRA14=0 F=1;RA14=1;G.40
550IFF=1 RA14=0;F=0;G.40
560F=1;G.40
570E.
580IF X=T RA14=1
590IF X=U RA14=2
600u?C=X;I=0
610I=I+1;W=C;Y=0
620IF I=1 N=62
630IF I=2 N=66
640IF I=3 N=2
650IF I=4 N=64
660W=W+N
670IF ?W=X A.Y<>3 Y=Y+1;G.660
680IFY=3 G.r
690 IFW<>X G.710
700G.660
710N=-N;W=C
720W=W+N
730IF?W=X A.Y<>3 Y=Y+1;G.720
740IFY=3 G.r
750IF I<5G.610
760G.420
770W=W-N;I=0
780 ?W=O;?C=O;A=#8139
790I=I+1;?A=S;A=A+1;P.$?;IFI<9G.790
800?#8136=#17;?#8137=T;?#8138=#0E
810IFX=T E=E+1;G.530
820IFX=U L=L+1;G.530
```

Bone idle

W A Googe,
Stevenage,
Hertfordshire.

ZX-81

THIS IS a program for a 16K RAM ZX-81. It is widely recognised that the prime function of a computer is to make life easier for us all, but to program one to play Patience for you must be the ultimate in laziness. My excuse is that the computer can play faster than me, and it does not cheat. The game is Clock Patience, and the program should be entered and Run.

In reply to the L cursor the following data should be input, one number at a time, reading the data across the page. Follow each entry with Newline, and if correctly done, the last entry will produce a message 9/10.

Data: 3, 20, 2, 21, 1, 22, 0, 23, 6, 23, 5, 24, 4, 25, 3, 26, 10, 24, 11, 24, 10, 26, 11, 26, 15, 23, 16, 24, 17, 25, 18, 26, 18, 20, 19, 21, 20, 22, 21, 23, 18, 15, 19, 15, 20, 15, 21, 15, 18, 10, 19, 9, 20, 8, 21, 7, 15, 7, 16, 6, 17, 5, 18, 4, 10, 6, 11, 6, 10, 4, 11, 4, 6, 7, 5, 6, 4, 5, 3, 4, 3, 10, 2, 9, 1, 8, 0, 7, 3, 15, 2, 15, 1, 15, 0, 15, 12, 15, 11, 15, 10, 15, 9, 15, End of data.

List the program and delete lines 1 to 10 inclusive, by typing Line Number Newline. Do not use Run or Clear, or you will lose the data you have just entered, which is a list of the print positions for the cards.

You will need a copy of this exciting program, so get your recorder into a recording mood, type Goto390, start the recorder, and press Newline, the program will Autorun.

The computer will shuffle the cards and set them out in a clock-face pattern on the screen — it deals at random from a new pack each time which amounts to the same thing. Should the computer succeed in getting the game to come out, it will stop with message 9/380 and Cont Newline will start it off again.

If it fails, it will display the Ace that stopped it in the bottom left of the screen, and after a pause try again. Remember this is a program with hidden data stored within it, so to restart from a listing use Goto 11.

The computer plays at about two games per minute, and if such haste makes you dizzy, an extra line:

```
265 PAUSE 100
```

will slow things down a bit, or if you dislike the screen jump caused by Pause there is room for a dummy loop at that part of the program. On the other hand, if your patience is limited delete line 175, and insert:

```
222 SLOW
```

This will speed things up by not displaying the cards until after they have been set out.

The computer starts play with the top card from the one o'clock pile. If you wish it to start in the centre, change line 230 to read:

```
LET X = 13
```

and alter the first subscript of the arrays in line 370 to read 13 also.

If desired, the program can be altered to delete line 335. Replace it with:

```
235 PRINT AT (20+1**1),0;D$
236 PRINT AT (20+1**1),0;"  " (two
    spaces)
```

This will cause the card in the bottom left of the screen to flash, and demonstrate a novel use of the ** function to cause a slight delay — a good idea gleaned from somebody else's program, and deserving to be more widely known.

```
  1 DIM C$(13,4,2)
  2 DIM A(13,4,2)
  3 DIM T(13)
  4 FOR N=1 TO 13
  5 FOR M=1 TO 4
  6 INPUT A(N,M,1)
  7 INPUT A(N,M,2)
  8 NEXT M
  9 NEXT N
 10 STOP
 11 FAST
 12 RAND
 15 LET A=1
 20 LET K=13
 30 LET Q=12
 40 LET J=11
 50 LET T=10
 60 LET B$="AS2S3S4S5S6S7S8S9ST
SJSQSKSAD2D3D4D5D6D7D8D9DTDJDQDK
DAC2C3C4C5C6C7C8C9CTCJCQCKCAH2H3
H4H5H6H7H8H9HTHJHQHKH"
 70 FOR N=1 TO 13
 75 LET T(N)=4
 80 FOR M=1 TO 4
 90 LET P=INT (RND*LEN B$)+1
100 IF P/2-INT (P/2)=0 THEN GOT
O 140
110 LET C$(N,M)=B$(P TO P+1)
120 LET B$=B$( TO P-1)+B$(P+2 T
O )
130 GOTO 160
140 LET C$(N,M)=B$(P-1 TO P)
150 LET B$=B$( TO P-2)+B$(P+1 T
O )
160 NEXT M
170 NEXT N
175 SLOW
180 FOR N=1 TO 4
190 FOR M=1 TO 13
200 PRINT AT A(M,N,1),A(M,N,2);
"  "
210 NEXT M
220 NEXT N
225 LET R=0
230 LET X=1
240 LET Y=T(X)
250 PRINT AT A(X,Y,1),A(X,Y,2);
"  "
260 LET D$=C$(X,Y)
270 LET T(X)=T(X)-1
280 LET X=VAL C$(X,Y,1)
285 LET Y=T(X)
290 IF Y=0 THEN GOTO 330
310 PRINT AT A(X,Y,1),A(X,Y,2);
D$
315 LET R=R+1
317 IF R=51 THEN GOTO 370
320 GOTO 260
330 FOR N=1 TO 100
335 PRINT AT 21,0;D$
340 NEXT N
350 CLS
360 GOTO 11
370 PRINT AT A(1,4,1),A(1,4,2);
C$(X,Y)
380 STOP
385 GOTO 11
390 SAVE "CLOCK"
400 GOTO 11
```

Music maestro

Roger Keatley,
Wolverhampton.

DRAGON

THE PROGRAM allows the user to enter, modify, insert, play, load and save a piece of music. The standard Dragon music symbols are entered into a line where each symbol may be separately addressed. Music is entered using the E command in the form:

E(START)/(TEXT)

Where Start is the first position to place a symbol and Text the string to use — can be more than one symbol. If you enter on an existing symbol Modify is effected. Symbols can be inserted into the line using the I command in the form:

I(START)/(TEXT)

Where Start is the position to start on and Text the symbols to be inserted there are no default values for these commands. They should be entered in full. The music string can be played using the P command as follows:

P(LINE NUMBER)

Where Line Number is the line to play — 20

(continued on next page)

(continued from previous page)

lines are available. Leaving the line number off will cause the Dragon to play all the lines entered.

The L command changes the line number which music is entered into. Use:

L = (LINE NUMBER)

Do not leave the line number off. The command New removes all the symbols from the lines. Use this to start again. When you have completed your masterpiece you can save it on to tape using the Save command:

SAVE/(FILENAME)

Where Filename is the name you want to call the piece. Similarly Load can be used to get the file back from tape:

LOAD/(FILENAME)

As the program does not test the symbols entered you must make sure what you enter is a valid Dragon symbol. If it is not the program will halt when you try to play the symbol. If this does happen you can recover by entering Goto 50 — this will restart the program. You can then change the offending symbol.

If you have been running a high-resolution graphics program before using this one, switch the Dragon off, then on again before loading this one, as the program uses PClear1 to save memory.

```
10 ' DRAGON32 MUSIC WRITER
20 '
30 PCLEAR1:CLEAR2000:DIM M$(20)
40 CL=1
50 CLS
60 PRINT:PRINT:PRINT
70 PRINT@72,1:PRINT@82,2:PRINT@92,3
80 FOR T=1 TO 3
90 FOR C=1 TO 9
100 PRINTUSING "#";C;
110 NEXT C
120 PRINTUSING"#";0;
130 NEXTT
140 PRINTUSING"##";12;
150 PRINT@10,"LINE:";CL
160 PRINT@128,M$(CL)
170 PRINT@288,STRING$(30," ")
180 PRINT@192," "
190 PRINT
200 PRINT"INPUT COMMAND STRING"
210 LINE INPUT " >";C$
220 IF LEFT$(C$,1)<>"M" THEN 290
230 F=0
240 IF LEN(C$)>1 THEN F=1:PN$=RIGHT$(C$,(LEN(C$)-1))
250 IF F=1 THEN PN=VAL(PN$):PLAY M$(PN):GOTO 150
260 FOR C=1 TO 20:MX$=MX$+M$(C):NEXT C
270 PLAY MX$:MX$="":GOTO 150
280 '.... ENTER....
290 IF LEFT$(C$,1)<>"E" THEN 400
300 PC=INSTR(2,C$,"/")
310 PN=VAL(MID$(C$,2,PC-2))
320 IN$=RIGHT$(C$,(LEN(C$)-PC))
330 B$=LEFT$(M$(CL),PN-1)
340 B$=B$+IN$
350 IF PN>=LEN(M$(CL)) THEN 370
360 B$=B$+(RIGHT$(M$(CL),LEN(M$(CL))-(PN+LEN(IN$)-1)))
370 M$(CL)=B$
380 GOTO 150
390 '.... CHANGE LINE.....
400 IF LEFT$(C$,2)<>"L=" THEN 450
410 CL=VAL(RIGHT$(C$,(LEN(C$)-2)))
420 IF CL>20 THEN PRINT:PRINT" 20 LINES ONLY !!":CL=1:SOUND180,17
430 PRINT@352,STRING$(32," ")
440 GOTO 150
450 '... SAVE.. ???????
460 IF LEFT$(C$,4)<>"SAVE" THEN 570
470 F$=RIGHT$(C$,(LEN(C$)-5))
480 PRINT:PRINT"PRESS ENTER WHEN RECORDER READY"
490 IF INKEY$="" THEN 490
500 PRINT:PRINT"OUTPUT OF "F$" IN PROGRESS"
510 OPEN "O",#-1,F$
520 FOR C=1 TO 20
530 PRINT #-1,M$(C)
540 NEXT C
550 CLOSE #-1
560 GOTO 40
570 IF LEFT$(C$,4)<>"LOAD" THEN 690
580 F$=RIGHT$(C$,(LEN(C$)-5))
590 PRINT:PRINT"PRESS ENTER WHEN RECORDER READY"
600 IF INKEY$="" THEN 600
610 PRINT"  INPUT IN PROGRESS"
620 OPEN "I",#-1,F$
630 PRINT"FILE:"F$" FOUND AND LOADING"
640 FOR C=1 TO 20
650 INPUT #-1,M$(C)
660 NEXT C
670 CLOSE #-1
680 GOTO 40
690 IF C$<>"NEW" THEN 710
700 RUN
710 '... INSERT.....
720 IF LEFT$(C$,1)<>"I" THEN 810
730 PC=INSTR(2,C$,"/")
740 PN=VAL(MID$(C$,2,PC-2))
750 IN$=RIGHT$(C$,(LEN(C$)-PC))
760 B$=LEFT$(M$(CL),(PN-1))
770 B$=B$+IN$
780 B$=B$+RIGHT$(M$(CL),(LEN(M$(CL))-PN+1))
790 IF LEN(B$)>32 THEN GOSUB 820:M$(CL)=LEFT$(B$,32) ELSE M$(CL)=B$
800 GOTO 150
810 SOUND180,19:GOTO 150
820 PRINT:PRINT"  >> TRUNCATION <<":SOUND180,20
830 PRINT@352,STRING$(15," ")
840 RETURN
```

Box spin

W Meadowcroft,
High Crompton,
Oldham.

LYNX

THE EXCELLENT graphics capabilities of the 48K Lynx are demonstrated by this program, which draws the visible sides of a rotating 3-D box. If lines 230, 250, 270 and 290 are omitted, then a skeleton frame of the box is drawn. If line 180 is omitted, geometrical patterns are built up. Here is a list of the variables:

- A = Maximum width of sides
- B = Maximum width of ends
- T = Angle of turn
- D = Current width of sides
- P = Current width of ends
- S = Perspective
- W = Reduction in width of sides
- F = Reduction in height of ends

```
100 LETA = 100
110 LETB = 25
120 FORT = 0 TO 360 STEP 10
130 LETD = A * COS (RAD(T))
140 LETP = B * SIN (RAD(T))
150 LETS = 2 * P/3
160 LETW = ABS(S/4)
170 LETF = D/25
180 CLS
190 INK2
200 MOVE 128,70
210 DRAW 128,180
220 INK7
230 IFP<0 THEN GOTO 250
240 PROC ENDA
250 IF D-W<W-D THEN GOTO 270
260 PROC SIDEA
270 IF P>0 THEN GOTO 290
280 PROC ENDB
290 IF D+W>- (D+W) THEN GOTO 310
300 PROC SIDEB
310 PAUSE 5000
320 NEXT T
330 RUN
340 DEFPROC SIDEA
350 MOVE 128+D-P-W, 150+S+F
360 DRAW 128-D-P+W, 150-S+F
370 DRAW 128-D-P+W, 100+S-F
380 DRAW 128+D-P-W, 100-S-F
390 DRAW 128+D-P-W, 150+S+F
400 ENDPROC
410 DEFPROC ENDA
420 MOVE 128+D-P-W, 100-S-F
430 DRAW 128+D+P+W, 100-S+F
440 DRAW 128+D+P+W, 150+S-F
450 DRAW 128+D-P-W, 150+S+F
460 DRAW 128+D-P-W, 100-S-F
470 ENDPROC
480 DEFPROC SIDEB
490 MOVE 128-D+P-W, 100+S+F
500 DRAW 128+D+P+W, 100-S+F
510 DRAW 128+D+P+W, 150+S-F
520 DRAW 128-D+P-W, 150-S-F
530 DRAW 128-D+P-W, 100+S+F
540 ENDPROC
550 DEFPROC ENDB
560 MOVE 128-D+P-W, 100+S+F
570 DRAW 128-D-P+W, 100+S-F
580 DRAW 128-D-P+W, 150-S+F
590 DRAW 128-D+P-W, 150-S-F
600 DRAW 128-D+P-W, 100+S+F
610 ENDPROC
```

Extra colours

Patrick Hill,
Walsall.

DRAGON

THIS PROGRAM was devised to produce more colours on the Dragon 32. It forms colours by drawing alternate lines of two colours, the numbers of which are contained in C and C1. This gives about 30 usable background colours which will support the usual graphics commands. I have used Draw for the alternate lines though Line works equally well.

```
10 CLS0
20  FOR A = 0 TO 1
30 PMODE3,1:SCREEN1,A:PCLS
40  FOR C = 1 TO 4
50  FOR C1 = 1 TO 4
60 P = 1
70  IF P + C1 = C THEN P = P + (C
     1 + 1)ELSEP = P + C1
80  FOR J = 1 TO 196 STEP 2
90  DRAW "BM0,"+  STR$ (J)
100  DRAW "C"+  STR$ (C) + "M252
     ,"+  STR$ (J)
110  DRAW "BM0,"+  STR$ (J + 1)
120  DRAW "C"+  STR$ (C1) + "M25
     2,"+  STR$ (J + 1)
130  NEXT J
140 CIRCLE(128,96),75,P
160 PA INT (128,90),P,P
170  FOR K = 1 TO 1000: NEXT K
180 PCLS1
190  NEXT C1
200  NEXT C
210  NEXT A
```

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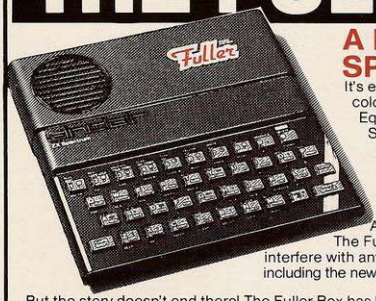

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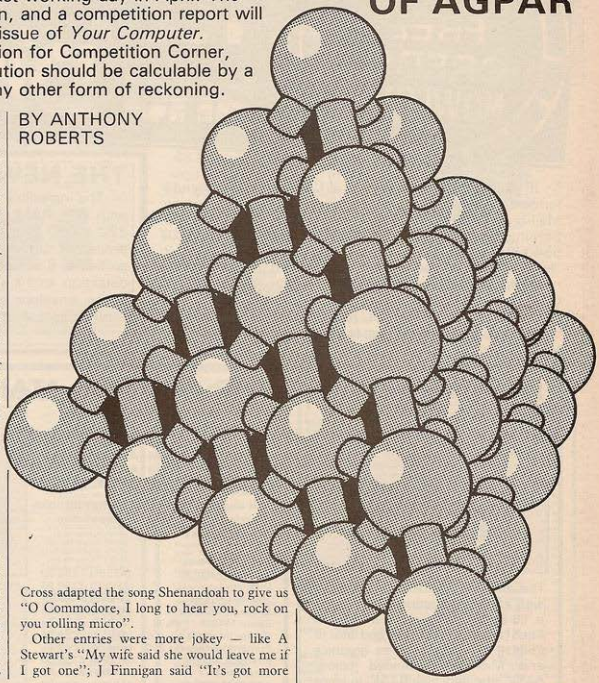
COMPETITION CORNER

A £15 book token will be awarded to the first correct solution drawn from the competition bag. All entries must be at the *Your Computer* offices by the last working day in April. The name of the winner, the solution, and a competition report will be published in the June, 1983 issue of *Your Computer*.

If you want to set a competition for Competition Corner, remember that the simplest solution should be calculable by a short program rather than by any other form of reckoning.

THE PYRAMID OF AGPAR

BY ANTHONY ROBERTS



AT THE bottom of the Agpar Sea lies the massive, millennia-old Globe Pyramid — a structure bristling with solar-powered defences, but which contains the last remaining matrix-stones — just what you need to teleport off Agpar before it is swallowed up by the black hole which has all but consumed Agpar's twin suns. There will be only 24 hours to gather as many stones as you can after the suns are finally extinguished, turning off the Pyramid's defences. You can only pray that you can gather enough!

The Globe Pyramid is a tetrahedron in shape — a pile of 35 globes on a triangular base, five to an edge. Each globe is connected to its immediate neighbours via a closed tube, and one stone is to be found at each end of each tube. Once inside a globe, you can gather all the stones from the ends of the tubes leading into it: but it takes an hour to break through a tube, and six hours to break into a globe from the outside. How many stones can you get?

Competition results

THERE WAS a large number of entries for February's competition to win a Commodore 64 — but no obvious winner. The sentence to be completed was: "a Commodore 64 allows me to do so much more . . .". Many entries called for musical accompaniment: "I'll still need it, I'll still feed it, when I'm sixty four" was M Clark's version of the Beatles lyric. E Cross adapted the song Shenandoah to give us "O Commodore, I long to hear you, rock on you rolling micro".

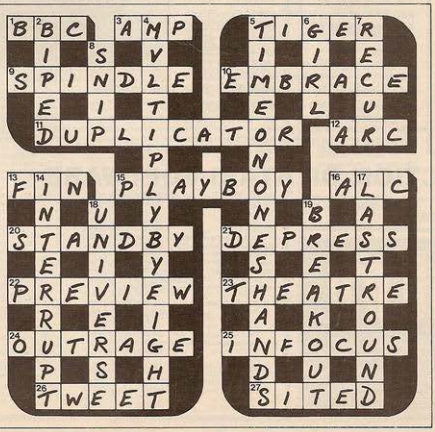
Other entries were more jokey — like A Stewart's "My wife said she would leave me if I got one"; J Finnigan said "It's got more bytes than a ship's cat hosting a flea convention". Rob Munday was refreshingly direct with "Reasons! Why do you always want reasons! Just send the computer" while the Rev D Tordoff made the special plea that "VICars need much bigger memories — without the temptation of Apples".

The 64's relation to the rest of the Commodore family was a common theme. P Farey confided "A Pet can be so restricting, don't you think?" and P Birch suggested that "It's 64 of one and half a cousin of a Pet".

These were all in the running but after much deliberation we awarded the prize to W Bellini, 27 Edgecombe Park Drive, Crowthorne, Berkshire, who turned the sentence into a near-limerick with "colourful sprites, and sound that delights keep programs from being a bore".

The solution to the Orb Bomb Puzzle was that three twists were the minimum number required to defuse the bomb. A Scott, 55 Huntley Grove, Peterborough, PE1 2QW, did not supply a program solution but explained that it was much easier to consider the bomb as a two-by-two by two Rubik's cube. Several other entries took the same approach. ■

Solution to the February crossword which offered a Commodore 64 as the prize.



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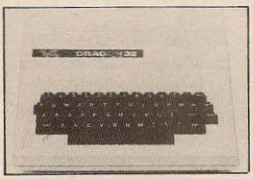
DRAGON 32



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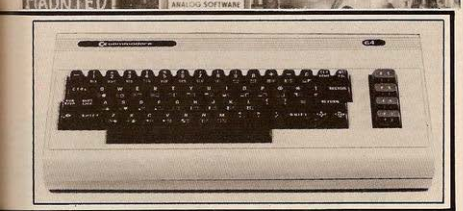

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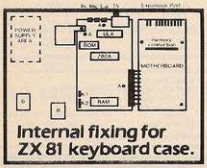
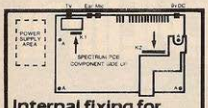


Internal fixing for ZX 81 keyboard case.



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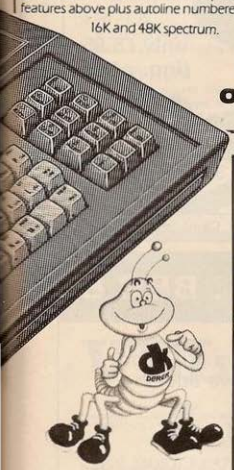

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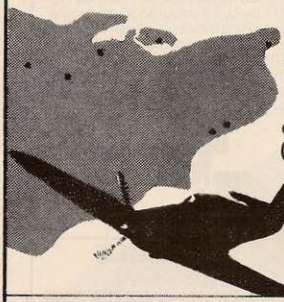

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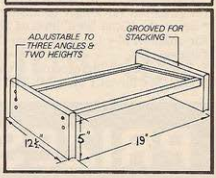

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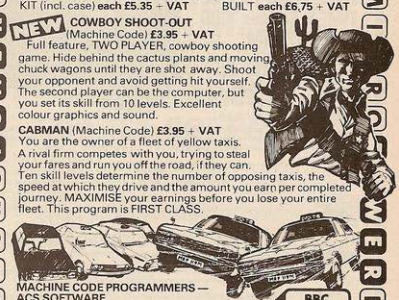

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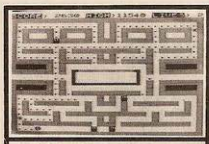

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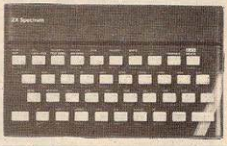

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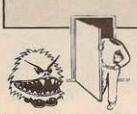

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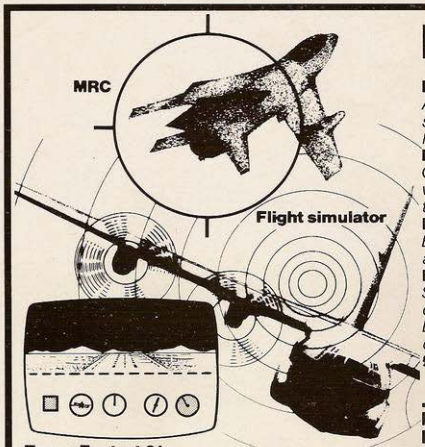

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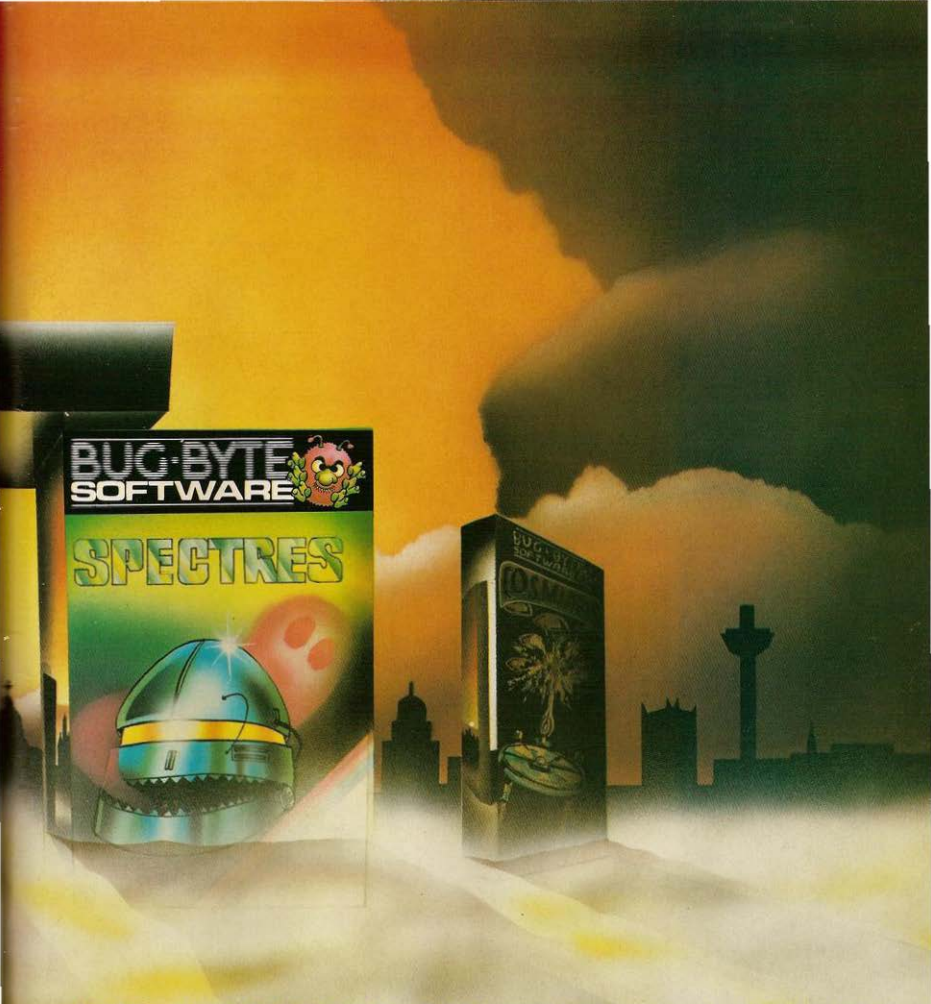
BUG-BYTE SOFTWARE, MORE THAN A GAME

All about me was darkness. Tens of thousands of screens stared blankly into space. Minds drifted aimlessly, dulled by lack of stimulation. The world was grey, drab, lacking . . .

Then suddenly it happened. First one, then another, then tens, hundreds, thousands of tired screens felt a surge of power and flickered back into life. They were much as I had seen on my own planet's microcomputers – the ZX 81, ZX Spectrum, Vic 20, BBC Micro and ORIC-1.

The minds paused to take stock. They clustered round the screens, their nimble fingers excitedly flicking the controls back and forth. At last they had found a challenge . . . action and adventure with cunning tests of dexterity and reaction. Everywhere, conversation was of Asteroids, Mazogs, Panic, Another Vic in the Wall.

Unable to resist, I too had a closer look. There before me was vivid colour, high resolution graphics. I could practically feel the spine-tingling



...IT'S A DOOR TO ANOTHER DIMENSION !

sound effects as whole battle fleets of Cosmiads swarmed out of nowhere and attacked. I should have known. As my fingers raced over the controls, and I prepared to stand and fight with only a single laser bolt for protection, I realised I was trapped!

Too late now, I remembered this was no ordinary software. I'd been warned, as I now warn anyone buying from Laskys, W.H. Smith, Currys Micro C, Spectrum and larger branches of Boots, and a nationwide network of dealers stocking Bug-Byte. Because Bug-Byte is more than a game, it's a door to another dimension. One that I had opened.

BUG-BYTE SOFTWARE

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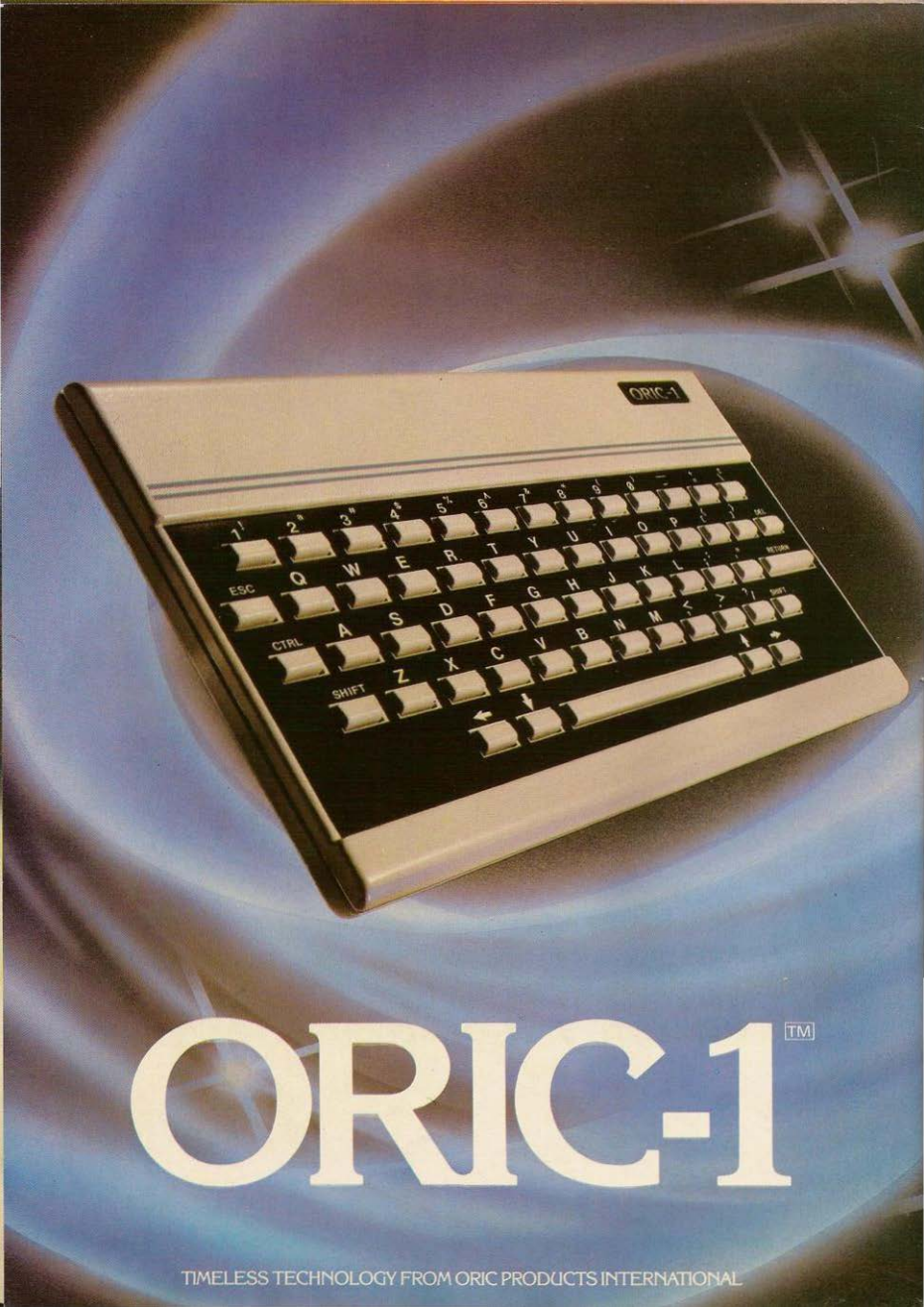
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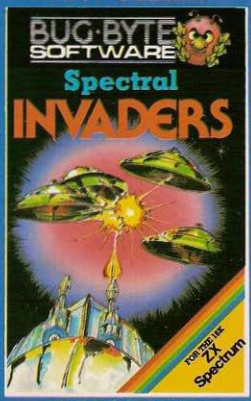

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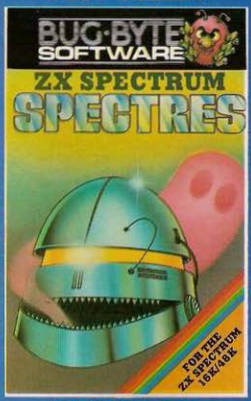

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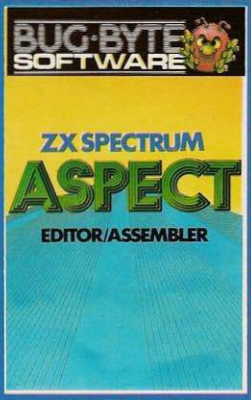

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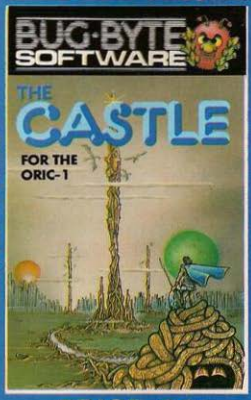

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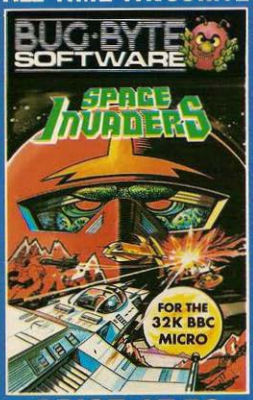

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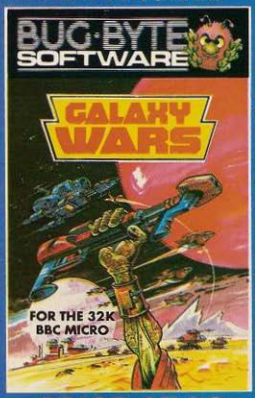

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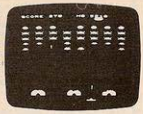

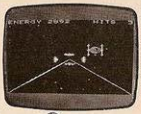

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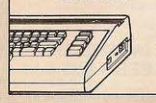

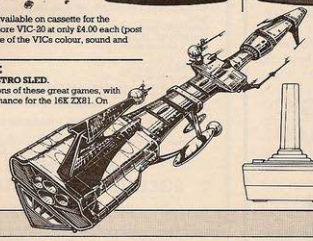

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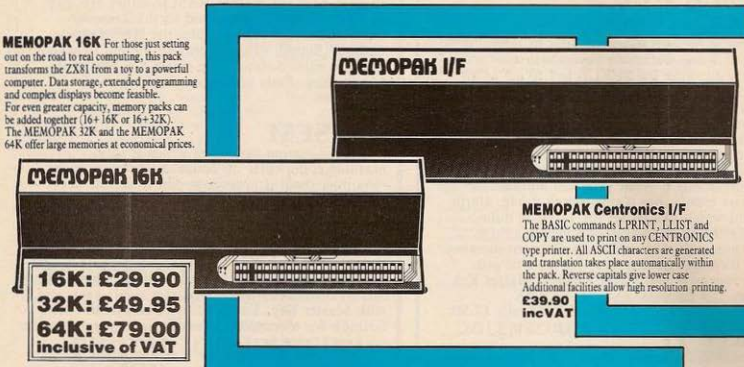

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The example system which is shown, on the other hand would satisfy the needs of someone who wanted to enter dat

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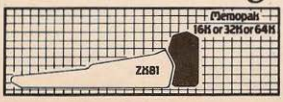

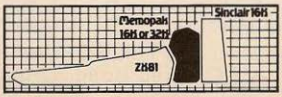

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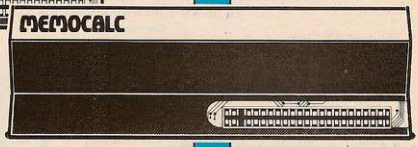

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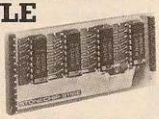

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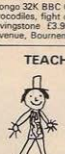

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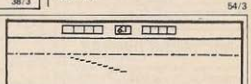

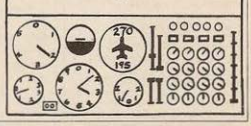

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Fig. 1

Fig. 2

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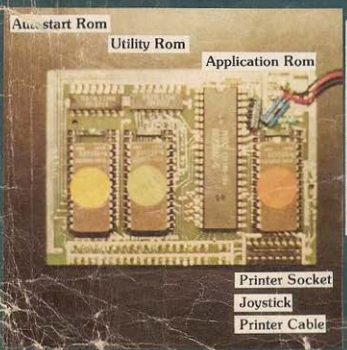

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